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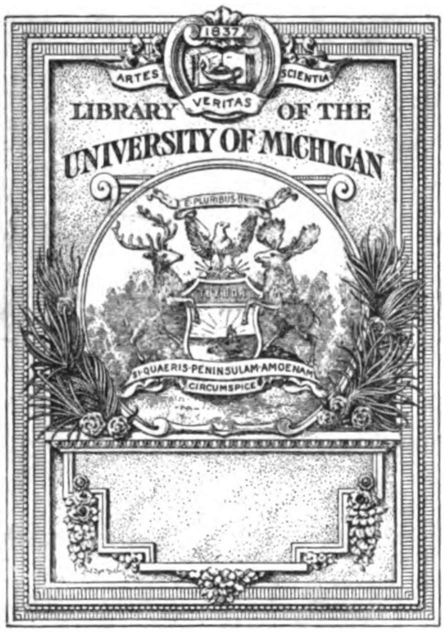
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ELECTRICAL INDUSTRIES.

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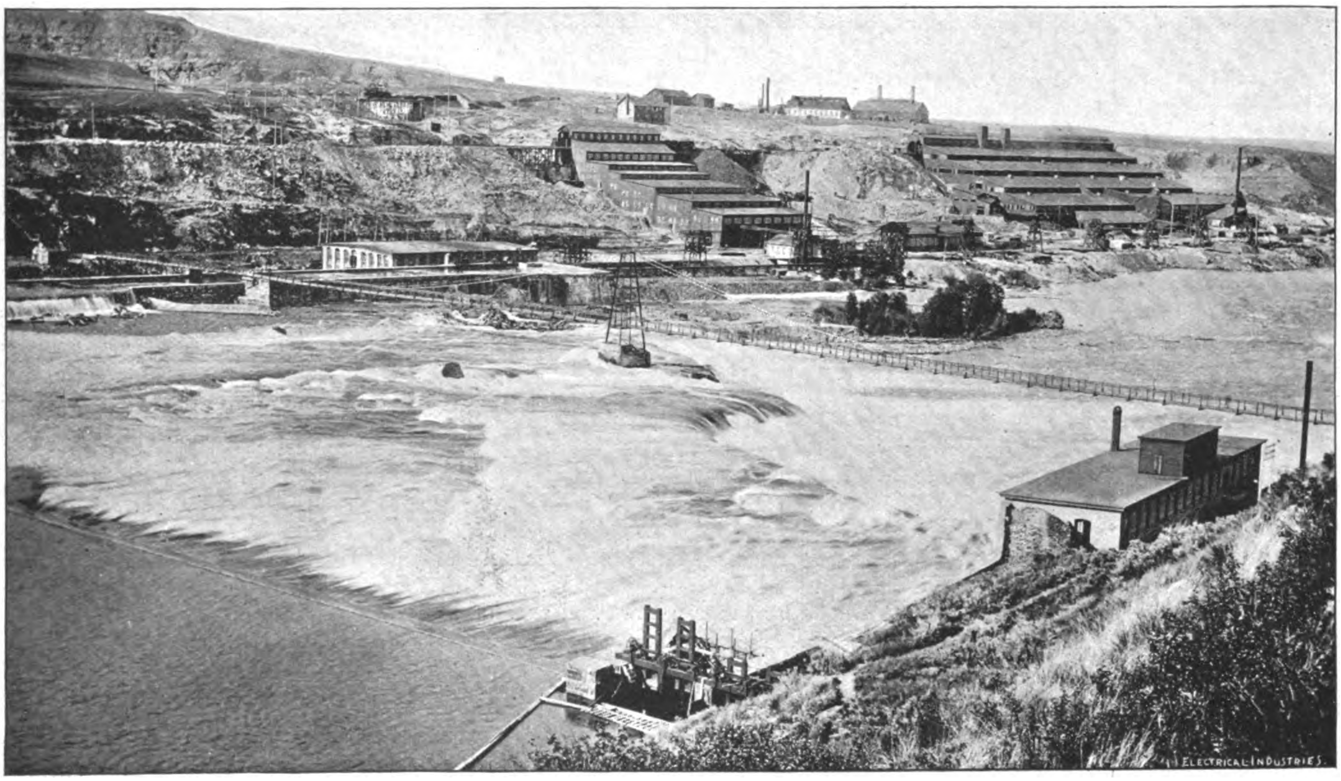
The Electric Lighting and Street Railway Plant, Great Falls, Montana.

The Missouri River at great Falls, Montana, falls 517 feet in a distance of seven miles in a series of falls and rapids, all of the former being so situated that the water power of each can be cheaply developed. The larger of the falls are Black Eagle Falls, 30 feet; Rainbow Falls, 48 feet; Crooked Falls 26 feet, and lastly the Great Fall having a perpendicular drop of 92 feet. As compared with the largest water powers in the east and that of Minneapolis, Minn., the water power developed and undeveloped at Great Falls would aggregate 268,000-horse power while the water power at Holyoke, Mass, amounts to 12,260-horse power; at Lawrence, Mass., 11,000; Lowell, Mass., 11,845; Manchester, N. H., 12,000; Minneapolis, Minn., 52,000, and at Niagara, 120,000-horse power.



B, & M. Electric Power House.
Black Eagle Falls Dam.

Electrolytic Copper Refinery. B. & M. Smelter.
Boston & Great Falls Light & Power Co's Power House.

FIG. 2.—THE ELECTRIC LIGHTING AND STREET RAILWAY PLANT, GREAT FALLS, MONTANA.

Just above the Upper or Black Eagle Falls, the Great Falls Water Power & Townsite Company have erected a magnificent dam 12 feet high with forebays, gates, etc., all complete, at a cost of $250,000. This gives a head of 40 feet and a completed plant with 32,800-horse power available. On the north bank of the river the Boston & Montana Consolidated Copper & Silver Mining Company have erected and now have in sucessful operation their new and immense refining and smelting works, where each day over 700 tons of copper ore are concentrated, smelted and refined, its product acknowledged to be of the highest standard, being sent from the works in the form of ingots and electrolytic sheets. This company now utilizes over 5,000-horse power from the river, 1,000 of it being used in the electrolytic plant alone, which is many times larger than any other existing plant.

Upon the south bank of the river the Boston & Great Falls Electric Light & Power Company has its power house, a substantial structure 40 by 160 feet two stories high, built of stone and brick. At the dam 400 feet up the river from the power house one of the forebays supplies the 9 feet in diameter penstock which carries the water to the Victor horizontal turbines located upon the ground floor of the power house 12 feet above the water in the tail race. The wheels being so far above the water, this wheel floor is kept as clean and bright as one can desire. Upon the extended wheel shafts are the necessary clutch pulleys which are belted directly to the dynamos upon the floor above. One pair of wheels having a combined capacity of 400-horse power furnishes the power for four 50-light 2,000-candle power arc lamps with a reserve capacity for two more dynamos of the same size.

The second pair of wheels of 300-horse power are belted to two 1,300-light 16-candle power incandescent alternators. The third pair of wheels, 400-horse power capacity, are coupled together and belted to four 80-horse power power generators. A 12 foot fly wheel is connected with this wheel shaft by manilla ropes on grooved pulleys and tends to lessen the fluctuations in the speed caused by changes in load on the street railway. The fire pump is also connected with these wheels in such a manner that the throwing of a lever starts the pump which can throw two good fire streams. This pump is also used for pumping water into a 50,000 gallon water tank, located on the bluffs which rise nearly perpendicular 200 feet above the river.

Also upon this lower floor is located the oil room, lined with zinc and supplied with metal cans, filters and electric heater. The wheels are supplied with Snow governors which on the lighting circuits give very efficient regulation. They are not as satisfactory for street railway work, but probably as much so as any mechanical governor upon work where the variation of load is a large proportion of the entire load. The second floor of the power house which is devoted entirely to the dynamos, is very neatly finished and well arranged. The brick walls and the ceiling are painted white and the heavy 4-inch flooring is covered by narrow, matched Oregon pine, which is oiled and polished. The switch board located near the side wall at the center of the room is of matched oak, well braced and set out from the wall with plenty of room behind it. The wires from each dynamo pass down through the floor and in regular lines to the switch board, thence directly above to the wire tower, a room 40 feet long, 16 feet wide and 10 feet high, built on the roof of the power house. From here the different wires leave the building and are carried over the bluffs upon cross arms between heavy poles 12 ft. apart.

All of the turbines were furnished by the Stilwell-Bierce & Smith-Vaile Co., of Dayton, Ohio, who also furnished those for the smelting works across the river. The dynamo and switch board instruments were furnished by the old Thomson-Houston Company. The plant was installed in 1891, and the first water turned into the wheels in December of that year. The company is at present supplying 146 arc and 3,400 incandescent lights. The area covered by the system is four miles east and west and one and one-half miles north and south. Thirty-eight municipal lights are furnished at $14 per month each. The lights burn all night and every night. Commercial arc lights are furnished as follows: eight o'clock lights, $8.00 per month each; ten o'clock lights, $10.00 per month each; all night lights, $16.00 per month each.

Incandescent lights are furnished by contract at $1.15 each per month on 10 o'clock circuit, and $2.25 per month for all night lights of 16-candle power each, or by meter at one cent per lamp hour for 1,000 hours or less and eight-tenths of one cent for each lamp hour in amounts of over 1,000 hours. From all these rates a discount is made of ten per cent from all bills paid by the sixth of the month thus reducing the above rates very materially.

The power plant is located two and a half miles from the city center so that the cost for pole line wires is very great.

At present the incandescent circuit is operated at 1,000 volts reduced to 50 volts by T-H, transformers, but arrangements have been completed by which the current will leave the dynamos at 2,000 volts and be transformed to 50 volts wherever used, thus making a large saving in copper wires. All power is now operated from the 500-volt street railway circuit even for a distance of three and a half miles from the power house, the drop in potential is only ten per cent in that distance and as a good ground return is made by the street railway tracks and city water pipes the entire loss in voltage is not over 15 per cent even to the farthest point.

Supt. W. D. Dickinson is constantly applying his electric genius and power in the solution of difficult problems in the new applications of electricity. Power and current are used for a great variety of purposes in the city where either power or heat is desired, thus, because of its cheapness, convenience and utility supplanting many of the inventions and long established methods of manual labor, heating and cooking. Printing presses, elevators, rock crushers, water pumping, meat choppers, coffee grinders, mill machinery and mortar mixing are all done by this wonderfully subtile agent. The tailor heats his shop and goose with it. The dentist fans his patients and runs his office with motors from the electric "short order" house. The superintendent is ready for any emergency where electric power can be made available. He has furnished the power for some weeks to run the new flour mill, which has a capacity of 350 barrels per day and both the work and the flour is a success, a view of which is shown in the accompanying cut.

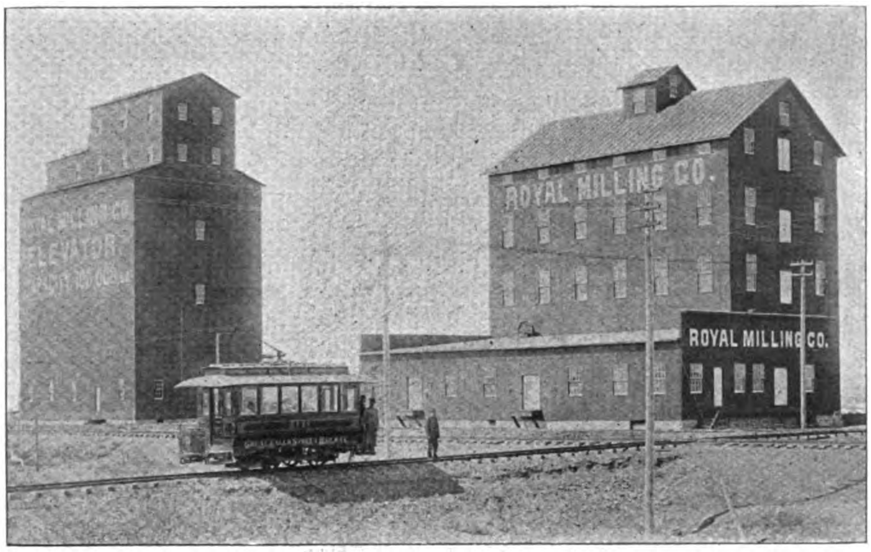


FIG. 2.—ELECTRIC LIGHTING AND STREET RAILWAY PLANT, GREAT FALLS, MONTANA.

The street railway company rents power from the light company. Its first rails were laid in 1890. It now has eleven miles of track at an outlay of $200,000. It operates the Thomson-Houston system with 0000 feeder and 0 trolley wires. The return circuit over one-half the line is made by a center return wire and over the other portion by a double bond between the rails. The rails used are 45 pound T and Johnson girder.

The cars used are from the Northern Car Company, of Minneapolis and the LaClede Company, of St. Louis, with the McGuire trucks. The motors are the Thomson-Houston W. P. 25-horse power. The cars are warmed by Carpenter electric heaters, the cost of which is nominal, the principal item being the renewal of burned out plates. The over head equipment was furnished by the Railway Equipment Co., of Chicago. The Light & Power company thus derive the larger part of its income from the sale of current for power. About 400 horse power is distributed about the city in small amounts for operating motors for every purpose to which power is applied.

The Auditorium Electric Lighting Plant.

The lighting plant recently completed for lighting the Auditorium building, the Auditorium Hotel, and the Auditorium Annex is probably the largest isolated plant in the world, having a capacity of 20,000 16-candle power lights. Although the buildings have three different names, the office building and hotel are built up as one which is reached from the annex through a tunnel under the street, so that the current is supplied to the entire number of lights as if they were in one building. In the accompanying cuts the general plan of the station is shown together with views of the apparatus installed. In the purchase of the equipment that which would render the best service for the money invested was selected after carefully studying the requirements of the plant.

The electric light plant is in itself but an incident in the general scheme which involved the establishment of a new station for furnishing light, power and heat to the three properties mentioned. The Auditorium Building and Auditorium Hotel had each its complete heat, light and power plant, which were being operated in quite a satisfactory manner both as regards general and economic efficiency. When the erection of the Auditorium Annex was determined upon and the consent of the City to the construction of the tunnel under Congress street had been obtained, the idea suggested itself that the concentration of all apparatus for the generation of heat, light and power in a single plant would develop economies of operation more than sufficient to pay interest on the cost of its erection. A careful examination of the problem was made and it was found that the saving in salary account alone would be very great; that by installing a steam generating plant of higher efficiency and larger engines direct coupled to the dynamos, further economies could be effected, and that the elevator pumping service which was called upon to develop power for the movements of twenty-three elevators could also be handled at greatly reduced cost.

The installation of the new plant was a matter involving many difficulties. The service in the old buildings had to be maintained without intermission while the changes and adaptations of the apparatus to the new condition of things were being made. All this has been successfully accomplished, although much of the temporary work, which had

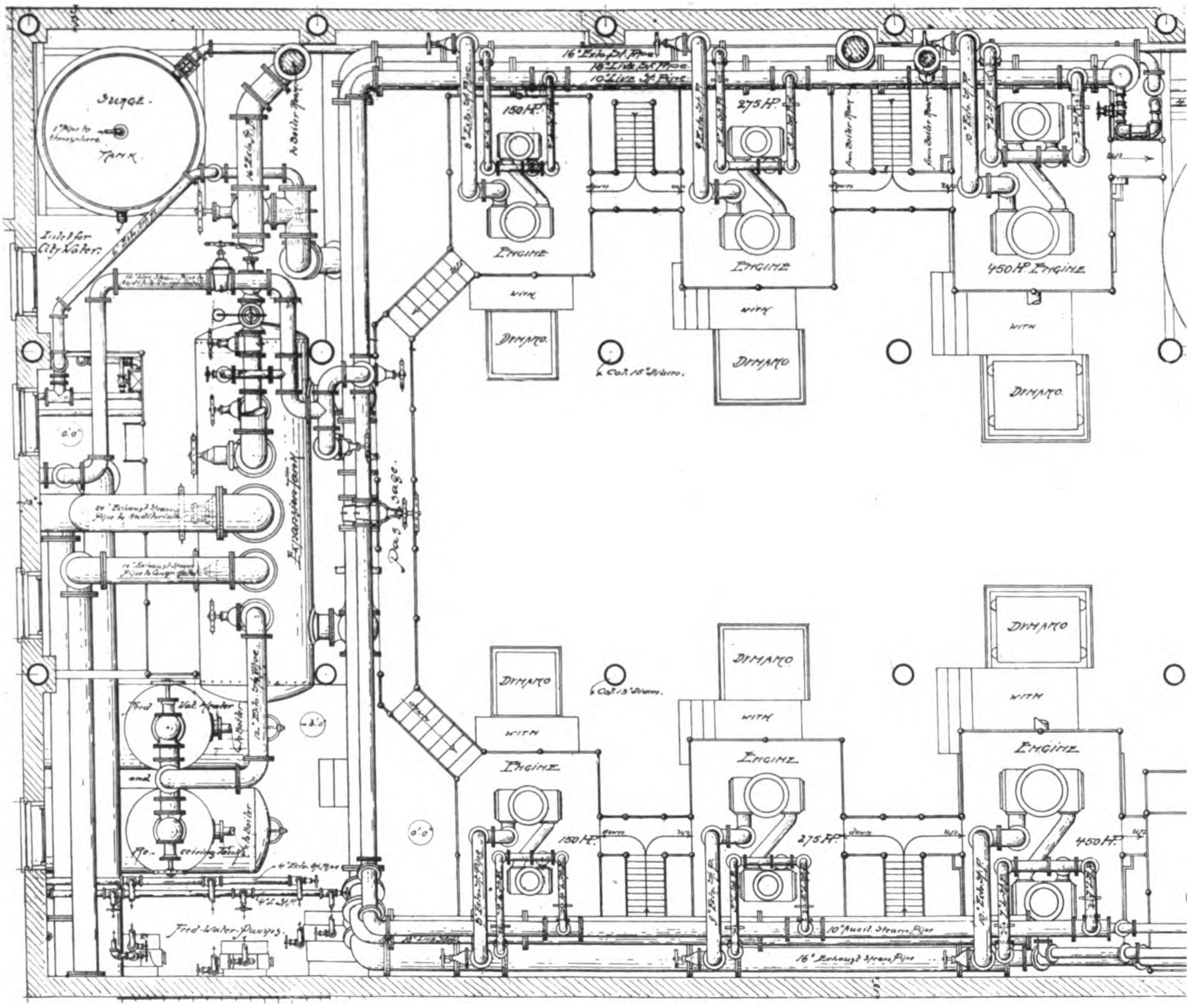


FIG. 1.—THE AUDITORIUM ELECTRIC LIGHTING PLANT.

to be done in view of the necessity for maintaining the service during the rush of business of the Fair year, is still in process of transformation into its final, permanent form. The plant therefore cannot as yet be called complete, but it will interest our readers to learn that we have been shown a memorandum made by the architects in June, 1892, which estimates the operating expenses of the new plant at $61,500 per annum, or $5,300 per month, and that the operating expenses for November, 1893, are slightly above, and those for December, 1893, will be slightly below that figure, thus leaving no doubt that upon the substitution of permanent work for the many temporary expedients still in use and the final adjustment of the entire plant, the cost of operation will be below the estimates made by the architects at the time of the first inception of the designs.

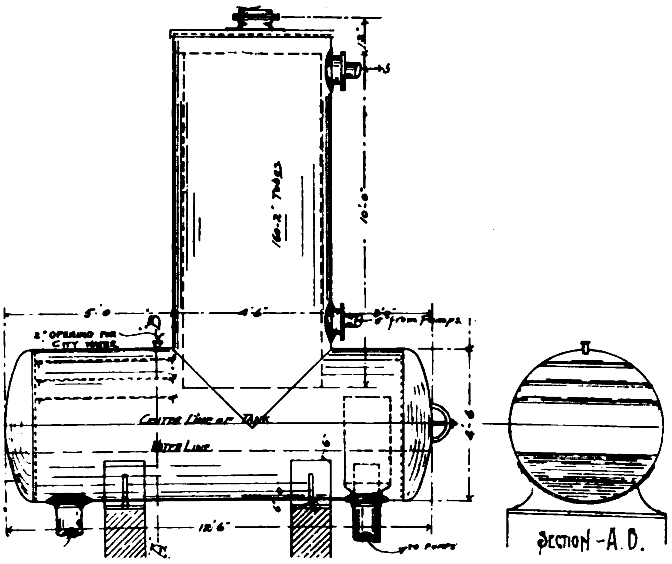


FIG. 2.—THE AUDITORIUM LIGHTING PLANT.

It will also interest our readers to know that the cost of operating the two original plants to wit, that in the Auditorium Building and the one in the Auditorium Hotel, was at the rate of $6,000 per month or $72,000 per annum, adding to which the proper amount for the cost of operating the Auditorium Annex, would bring the total cost of operation to $108,000, showing a saving of at least $46,500 per annum, which is over 15 per cent on the entire cost of the new plant.

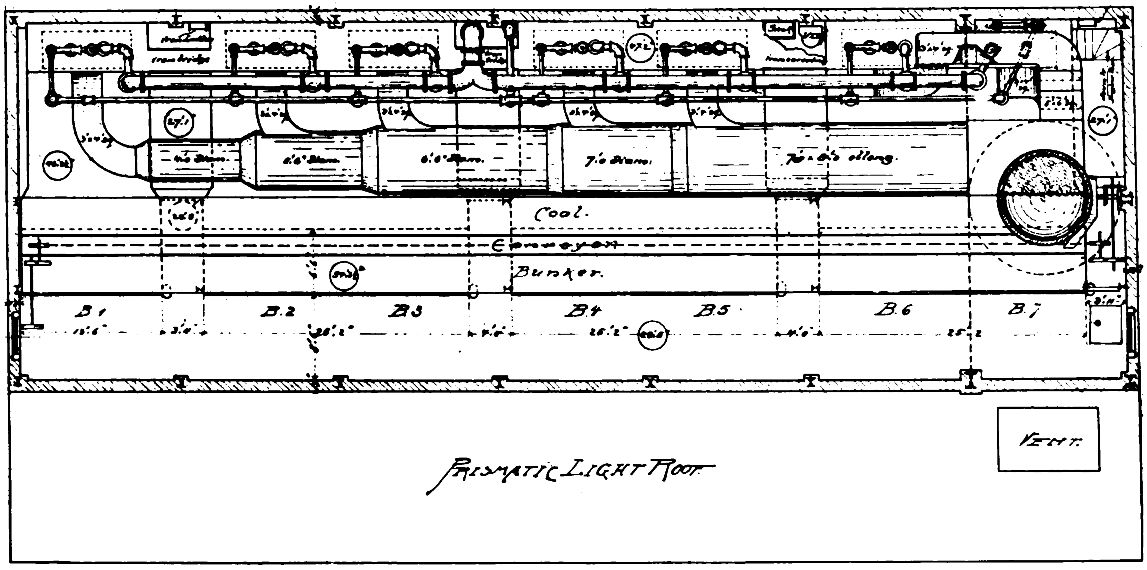


FIG. 4.—THE AUDITORIUM LIGHTING PALNT.

The boilers in the new power house, on the second story of the same, are seven in number, 243-horse power each, they are of Campbell & Zell make, and are provided with Murphy self-stoking furnaces; each boiler has 2,434 square feet of heating surface; nut coal and screenings are the fuel burnt which is kept in sheet iron hoppers above the boilers; the coal is received at the alley level and carried to the hoppers by means of a bucket elevator and distributed among them by a horizontal conveyor; the total capacity of the coal bunkers is 200 tons. In Fig. 3 which is an elevation of the boiler room, will be seen the relative positions of the coal bins, stoker and boilers, while in Fig. 4 is shown the plan of the boiler room with plan of smoke connections and steam pipes.

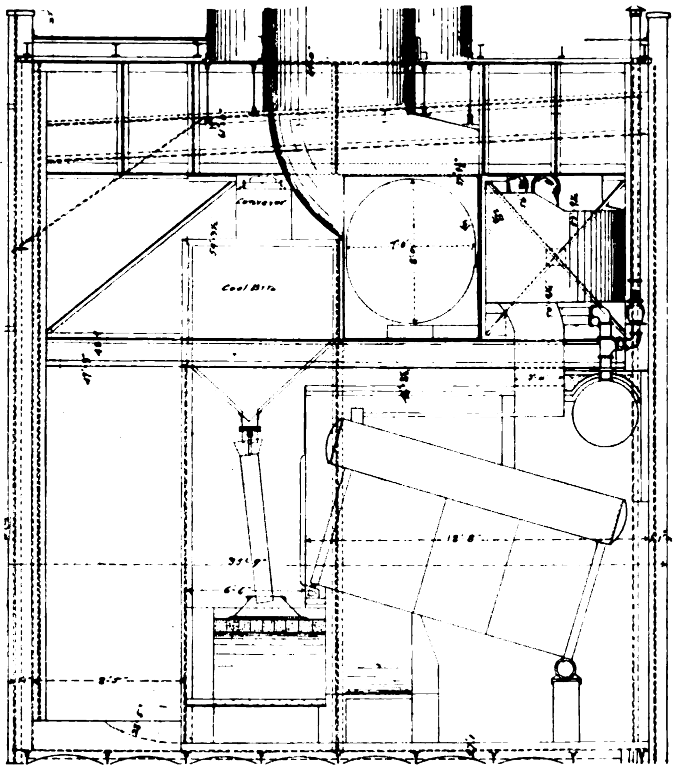


FIG. 3.—THE AUDITORIUM LIGHTING PLANT.

In the arrangement for the production and consumption of steam the economy of the system has been kept prominently in mind. The heat of the exhaust steam is utilized in a large feed water heater and purifier installed by Wm. Baragwanath & Son, of Chicago. The general design of the heater and purifier is shown in Fig. 2, and the position of the heater in reference to the pumps, steampipes, etc., is shown in the ground plan, Fig. 1.

Electric light current is generated by means of six Lake Erie engines and six Siemens & Halske multipolar dynamos direct coupled to the engines. Two of the generators have each a capacity of 100-kilowatts, two 193 kilowatts, and two 315 kilowatts. The solution of these units was based upon power curves, the development of which was the result of observations of the service required for the Auditorium Building, the Auditorium Hotel, and an effort was made to so divide the units that no matter what the variations of demand upon the generators might be, there would also be power at the disposal of the engineer approximately equal to the requirements of the service.

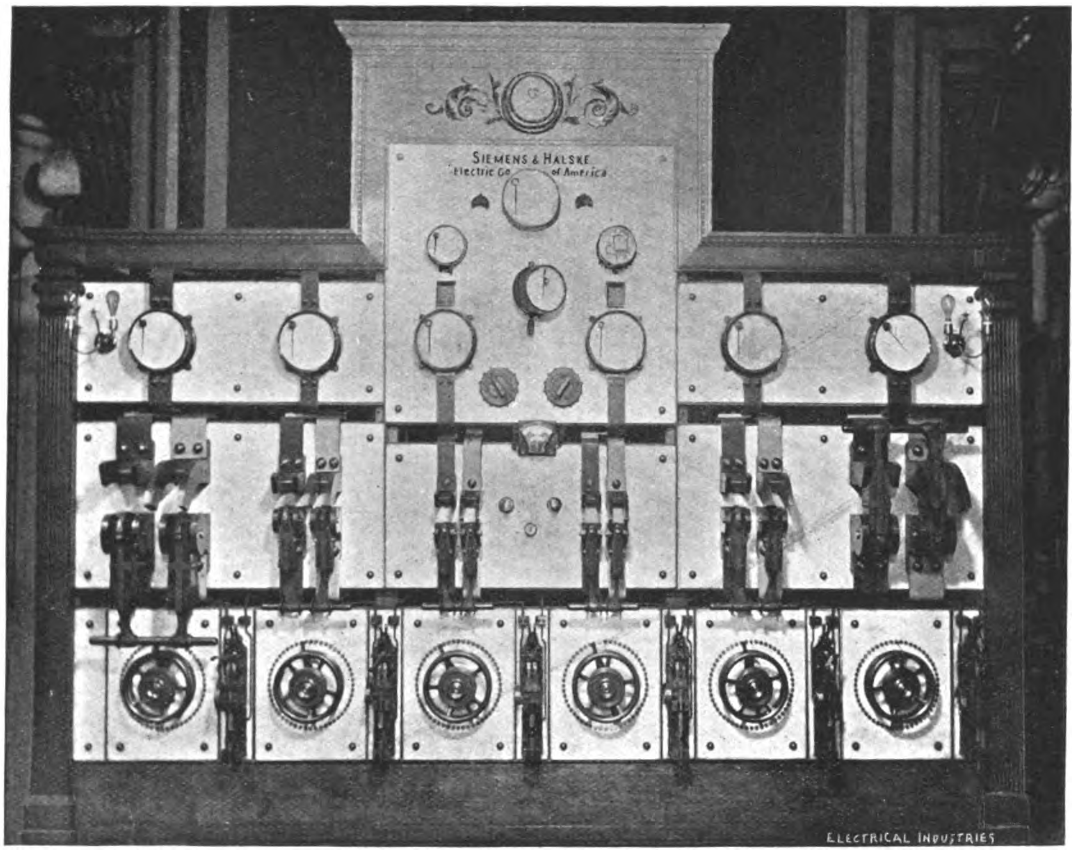


FIG. 6.—THE AUDITORIUM ELECTRIC LIGHTING PLANT—THE DYNAMO BOARD.

The plant has been planned with care. The arrangement as shown in the floor plan is open, roomy and convenient of operation. The engines, which are cross compound of the vertical type, carry the dynamo on the inner end of the engine shaft so that the dynamos are arranged on each side of the central passageway. The dynamo-regulating board is placed at the end of this aisle in plain view of each machine. This board, which is shown in Fig. 6 from a photograph, contains the switches for throwing the current from the machines on the system of distribution, the voltmeters and regulating rheostats. These instruments are mounted on heavy slabs of marble fastened by brass bolts to a substantial framework, the whole enclosed in a neat and ornamental frame. The dynamos are connected

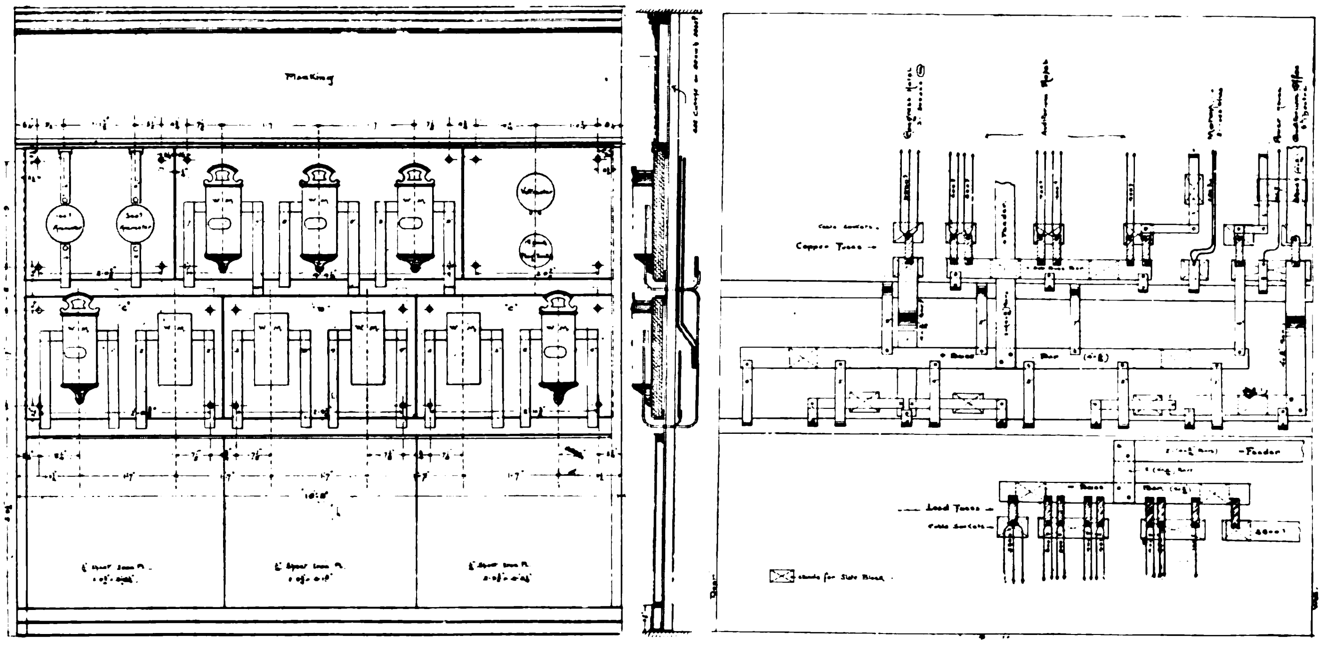


FIG. 7.—THE AUDITORIUM ELECTRIC LIGHTING PLANT—THE CENTER OF DISTRIBUTION.

to the board by heavy copper bars, well insulated, which are carried up from the machines across the room and down to the board.

From the dynamo regulating board the dynamo circuits are run to a distributing board which is similar in construction to the one described above. This board contains the fuse blocks, watt-meters which record the amount of current used in each division of the buildings and the riser terminals, those of the entire system terminating at this board. The wiring of the annex was done in interior conduit and the best rubber-covered wire was used. This work was done by the Auditorium company. The instruments, switches, etc., in use are of the Siemens & Halske make, the plant having been installed by the Siemens & Halske Electric Company of America. Messrs. Adler & Sullivan, the architects of the building, designed the entire plant. Mr. Chas. G. Armstrong was the consulting electrical engineer, under whose supervision the annex was wired and system changed from the old plant to the new.

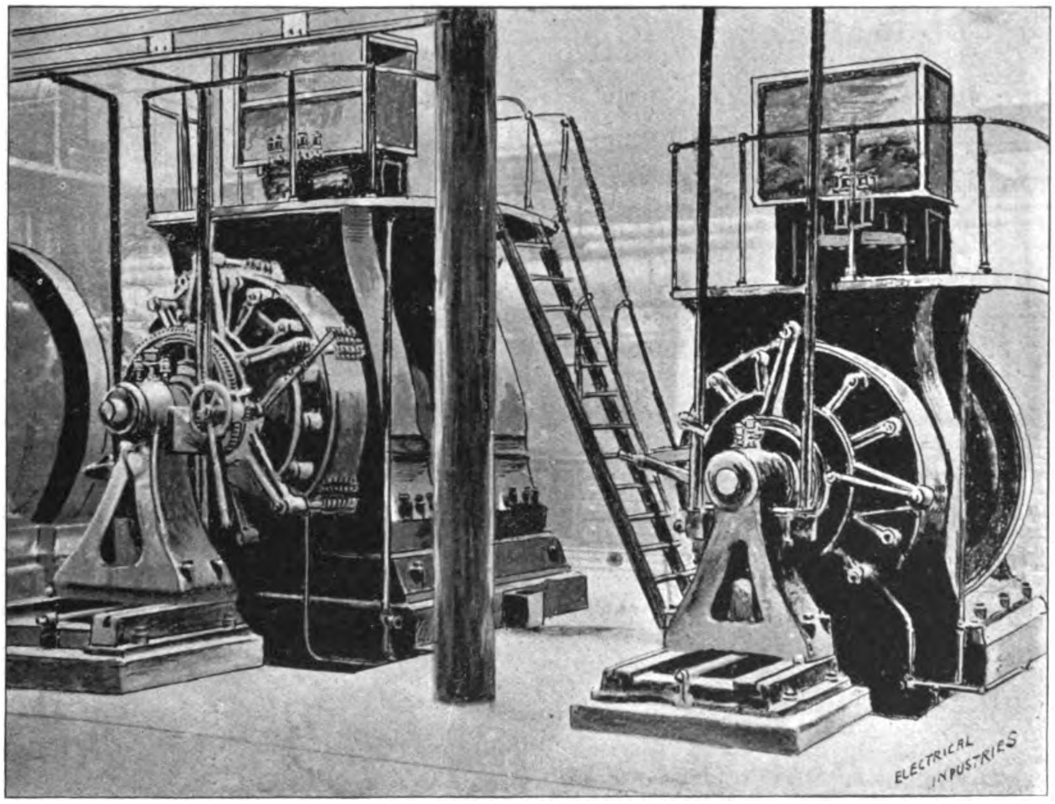


FIG. 8.—THE AUDITORIUM ELECTRIC LIGHTING PLANT.

New North Side Station of the Chicago Edison Co.

The results of the years of experience in central station construction and operation since the introduction of electric lighting are well shown in the more recently constructed stations. It is apparent in the buildings, in the machinery, in the arrangement of the stations, in the switch boards and in the systems of distribution. The north side station recently erected by the Chicago Edison Company is in every way a model station. It was planned with great care both as regards the equipment and its arrangement. It possesses an air of stability that indicates that it was built not only for the present, but for many years to come.

For supplying the district which is known as district No. 4, comprising the territory bounded by the river, the lake, North avenue and Wells street the station was erected. It is located near the center of the district at the recently erected Newbury Library building on North Clark street For the accommodation of the plant a very neat and substantial structure was erected at the Clark street end of the north side of the main building. Moulded red brick were used in its construction pointed on the outside, rubbed and painted on the inside. The roof is of fire proof tile construction. The building is the height of two stories, the floor being on a level with the basement floor. Thus an abundance of room is secured for handling the machines and an excellent ventilation.

The boiler-room is separated from the engine and dynamo-room by a heavy brick wall which affords a fire protection and also protects the dynamos and instruments from whatever dust may arise from work about the boilers. Each room is lighted by a central skylight of sufficient size to light all parts of the rooms. The floors are of granitized cement on a level with the top of the foundations.

In the boiler-room two boilers are in use while the future requirements of the station are in a measure provided for by the foundations which are in for three more. The boilers are of the Heine safety water tube type, of 365 and 200-horse power respectively. These boilers have 63½ and 33¾ feet respectively of grate surface and 2,770 and 1,450 square feet of heating surface.

They face the door leading to the dynamo-room so that the gauges are in plain view from the door or the pumps. Natural gas is used entirely for fuel, the supply being obtained from the street mains. The burners were put in by the Chicago Economic Fuel Gas Company under the direction of Mr. Mead. An eight inch pipe leads into the building from which a six inch branch is run in front of each boiler. At equal intervals along this pipe two-inch pipes run under the furnace. Along the upper side of these pipes the burners are set, which are a combination of a Bunsen burner and a mixer in which the gas and air are thoroughly mixed before combustion takes place. The tops of the burners project about an inch above the brick floor of the furnace which prevents the entrance of any air except such as enters through the burner. There is a valve in each two-inch pipe by which the gas may be shut off and as many burners used as desired. The furnaces are of the Hawley pattern which have been modified slightly to give an up draft. The many advantages of natural gas are at once apparent. The freedom from smoke, the dirt and dust attending the use of coal, the easy and close regulation of fires together with the small amount of labor required for its operation are important features. The employees express great satisfaction with this kinds of fuel, and the fact that the company is placing it in other plants would indicate that it is satisfactory from an economic point of view.

For utilizing the heat of the exhaust steam a 1,000-horse power Warren & Webster exhaust steam feed water heater and purifier has been installed. In the system many improvements have been introduced. The feed water is fed to the heater from the city mains, the supply being regulated by a float which closes the supply valve when the water in the heater reaches a certain point. As soon as more water is taken from the heater the float is lowered and the valve is open until the water again reaches the proper level.

This heater is placed high enough above the floor to allow a good lead to the feed-pumps placed near it. The difficulty often experienced in pumping hot water with the pump placed above the supply is entirely avoided by this arrangement. The pump is a Worthington vertical of the Admiralty pattern. The cylinders are nine inches in diameter, the water plungers six inches and the stroke of pump six inches. This style of pump was first designed for marine service and the same features that made it serviceable in that work causes it to meet the demands of the modern central station. It occupies but little floor space, all its internal parts can be easily got at, and it is simple and strong in its construction. The water passages are free and direct and the water valve may be easily replaced. The water pistons are accessible through the tops of the cylinders. A Worthington low service pump with steam cylinders six, water plungers five and three quarters and six-inch stroke has been installed for use should water at any time collect in the station sump.

Space has been arranged for the addition of a larger feed water pump which will be put in whenever the requirements of the station demand it. The arrangement of the steam pipes, the feed water heater, pumps and connections have been designed so that the space occupied is remarkably small for the capacity of the plant and still every part is accessible.

The steam main that carries the steam to the engine-room is 12 inches in diameter with four inch branches to the engines. The exhaust main is 20 inches, and the branches from the low pressure cylinders are seven inches in diameter. The engines are vertical cross compound, manufactured by the Lake Erie Engineering Works, of Buffalo, N. Y., of which one is of size D and two of size E. The dynamos are mounted on the ends of the engine shaft, making very compact combinations. The floor space occupied by each combination is less than seven by 10½ feet. The foundations are in for seven such combinations, the remainder of which will be installed as they are needed. When the full number are in position there will be grouped in a small space a station of large capacity so arranged that there is nothing that looks crowded but every part is open and easily reached.

These engines were designed especially for this class of work and are capable of being operated economically under the varying conditions of load. The cylinders are of the

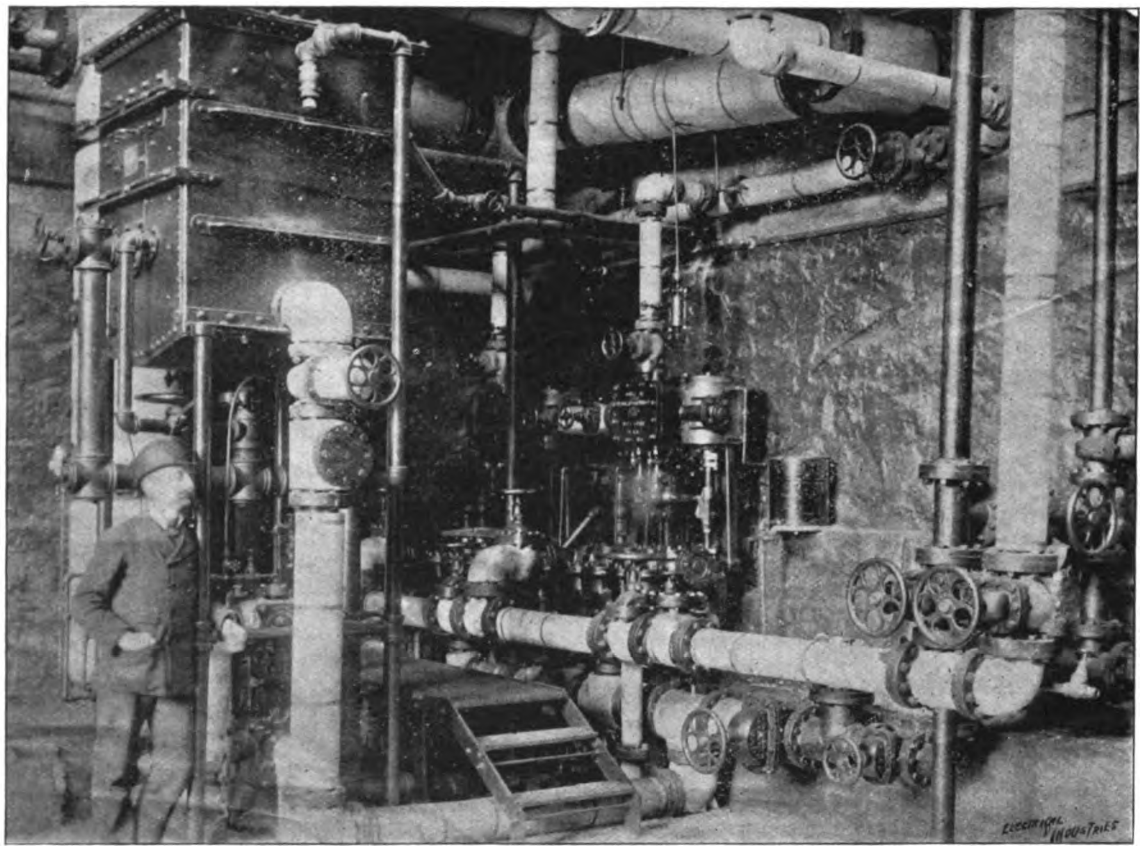
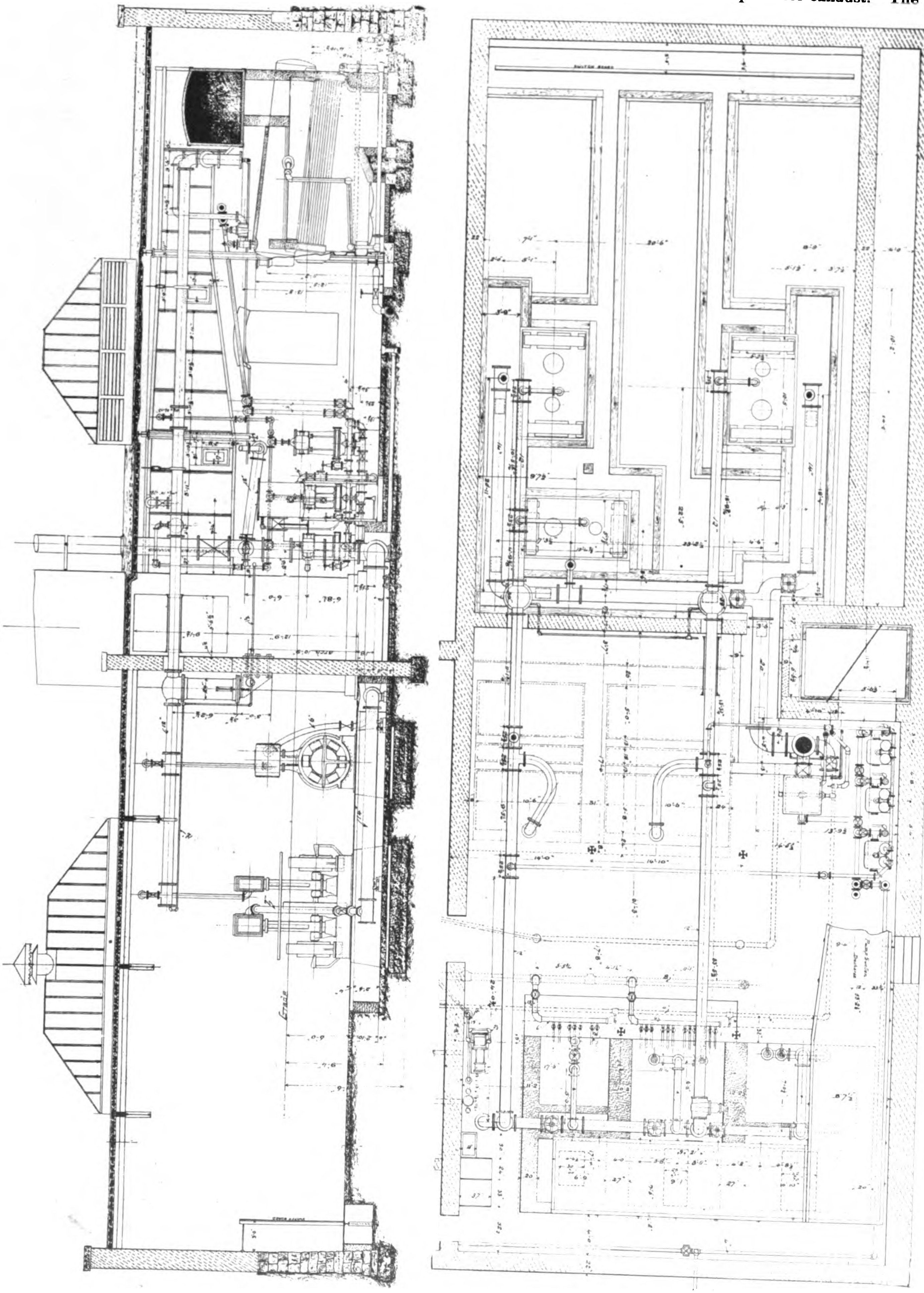


FIG. 1.—NEW NORTH SIDE STATION OF THE CHICAGO EDISON CO.

D engine, high pressure, 7¾ by 9; low pressure, 9¼ by 16½ inches, with a 14-inch stroke, and of the E engines high pressure, 9 by 10½; low pressure, 9½ by 19 inches, with a 16-inch stroke. The steam is received from the boilers at 150 pounds pressure and the engines run at 275 revolutions per minute. The cylinders are of the four valve type, two ports for steam and two ports for exhaust. The valves are of the double faced slide valve type and are four ported. The governor and steam valves are constructed so as to carry the steam as far as three-quarters of the stroke should it at



FIGS. 2 & 3—THE NORTH SIDE STATION OF THE CHICAGO EDISON CO.—PLAN AND ELEVATION.

any time be desired. The movement of the high-pressure admission valve is controlled by the centrifugal shaft governor by which the speed of the engine is regulated. The governor is exceedingly sensitive, not varying more in sudden changes of load than two and one-half per cent, which may occur when one-half the maximum load is suddenly thrown off. The main bearings of the engines are large and of sufficient size to be unaffected by heavy and sudden loads. All main working parts are water jacketed and are so arranged as to be easily removed and renewed in case of accident. The high pressure cylinders are steam-jacketed. The steam chest covers are covered with corrugated hoods.

The slides are on the inner surfaces of the heavy frame. The bed plates are heavy, well proportioned and securely anchored. In the construction of the working parts the best steel has been used. The crank shaft is of forged steel. The piston rod and cross head are of steel forged in one piece. From the accompanying cuts the general plan of the engines will be seen. Neat galleries surround the engine cylinders from which the valves may be operated or they may be operated by the hand wheel from the floor.

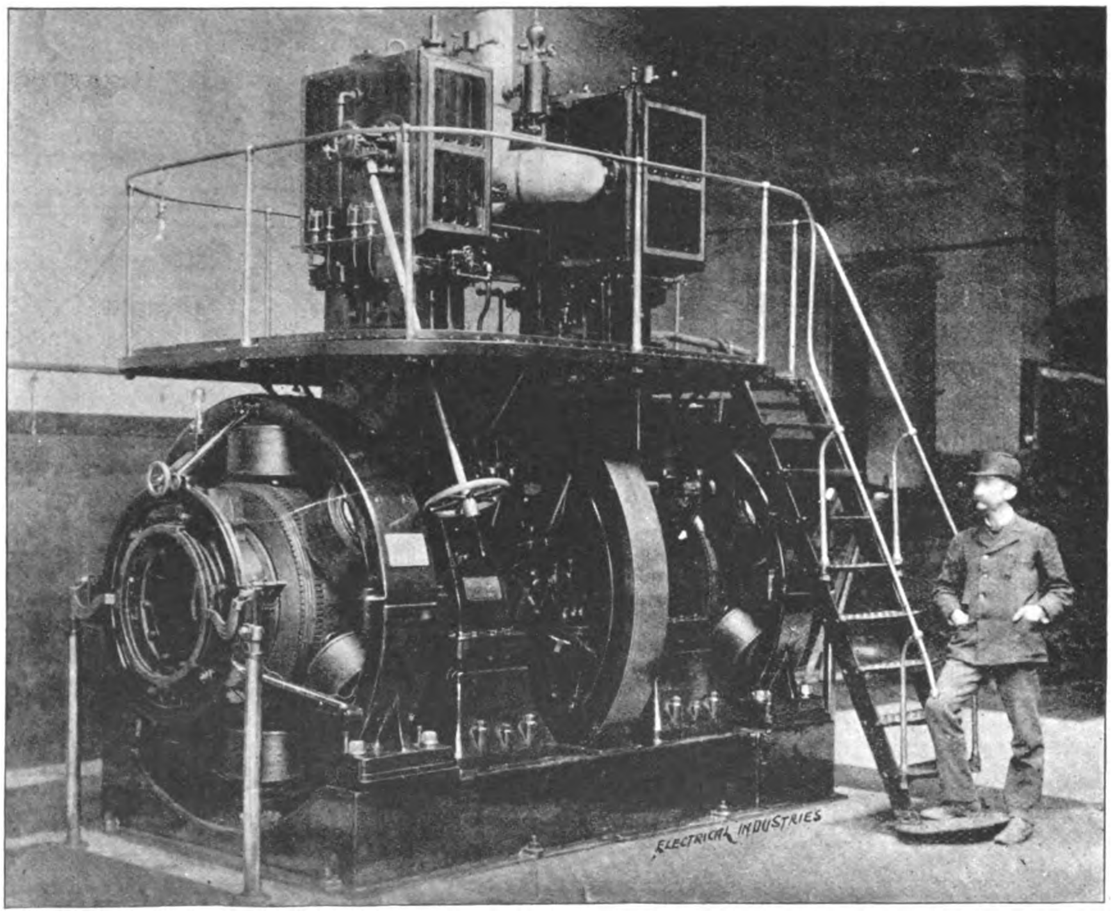


FIG. 4.—NEW NORTH SIDE STATION OF THE CHICAGO EDISON CO.

The dynamos are of the General Electric multipolar type with armature mounted on the engine shaft. They are of a type that was especially designed for central station service by the engineers of the company. The latest ideas regarding insulation and construction have been utilized. They operate at a low speed and as connected occupy but little floor space. The capacity of each generator is 550 amperes at 135 volts. The two dynamos of each combination are always used at the same time, one being connected on one side of the three wire system and the other dynamo on the other side. The brush holding frame is shifted by means of a hand wheel on a geared rod. From the brush holders the current is carried by means of lead covered cable which pass down the brass standard in front of each dynamo into the trenches beneath the floor and run to the switchboard. These trenches have been built in a very substantial manner with a cement bottom and sides of brick laid in cement. Iron brackets are placed at intervals in the brick work and support the cables. These trenches are covered by iron plates accurately fitted to place on a level with the floor.

The switchboard shows also the more advanced ideas of construction. The board itself is made of white Tennessee marble bolted by copper bolts to an iron frame work. The framework is built up of angle irons bolted together, anchored in the foundation and held in place by iron braces which are anchored in the rear wall. Everything about the board is of the most substantial character and every precaution is taken to secure perfect insulation. Ample space is left behind the board to make any alteration necessary. A large marble door hung on heavy polished copper hinges gives access to this part of the board. A row of incandescent lights suspended from the framework above give sufficient light for inspection. The board is made up of four parts according to the character of the work performed. Near the center of the board which extends across the east end of the dynamo room is located the testing panel. At the top of this panel is placed the feeder voltmeter below which is the neutral ammeter in circuit continuously.

In the center of the panel is the feeder pressure switch. The small wires which are brought back from each center of distribution where the feeders terminate and the mains are run off, terminate in small nickel contacts which are connected through the switch bar with the feeder voltmeter above. The contacts for each feeder circuit are placed side by side so that the difference of potential in each circuit at its point of distribution can at any time be quickly determined by the attendant at the station. On the lower part of the panel are two switches similar to the above by which the pressure wires from the dynamos are connected to the differential galvanometers that are mounted on a nickel frame set at an angle from the board so that the instruments can be read from any part of the room. By the use of these switches the voltage of the two dynamos of each combination is tested and brought up to the same voltage as the bus bars before being thrown on them. Double push buttons throw the galvanometers in and out so that when not in use there is no liability of their being injured by the current. On the same frame with the differential galvanometers are the bus bar voltmeters which show the voltage at all times of the positive and negative bus bars.

To the right of this panel is the dynamo regulating board. Each panel contains two ammeters, two voltmeters, two rheostats, and two double pole switches, one set for each dynamo of the double combination. The switches which are of heavy polished metal have the two sets of contacts placed about 45 degrees apart so that to change the currents from the dynamos to the opposite sides of the system requires but a slight turn of the switch. The voltmeters being placed side by side the difference in voltage between the two machines is quickly noticed. These switches like all the switches on the board are mounted on the board without bases. They are made of the special composition metal peculiar to the Lang switch. The bottom of the contacts are drawn out and a thread being cut it is screwed into the end of a short copper rod on the back of the board. The other end of this short rod is bolted to a small copper bar which in turn is bolted between the two bars of copper that form the bus bars. Wherever these connections are near the iron frame work heavy coverings of rubber are put on. The bus bars are made up of two and one half by one half inch bars and extend the entire length of the board. Porcelain saddles resting on iron brackets support the bus bars. The hand wheels of the rheostats alone are on the front of the board the coils themselves being mounted on the back. All the switches, brass and copper work were made from special patterns by J. Lang & Co.

To the left of the testing panel are the feeder panels. Each panel has an ammeter and switch for the positive and negative sides of the circuit while the switches for the neutrals are placed on a neutral board on the north side of the room. On each ammeter is a small nickel tag giving the street intersection to which that set of feeders run. The district is now covered by 15 sets of feeders. The standard Edison system is used for the underground work.

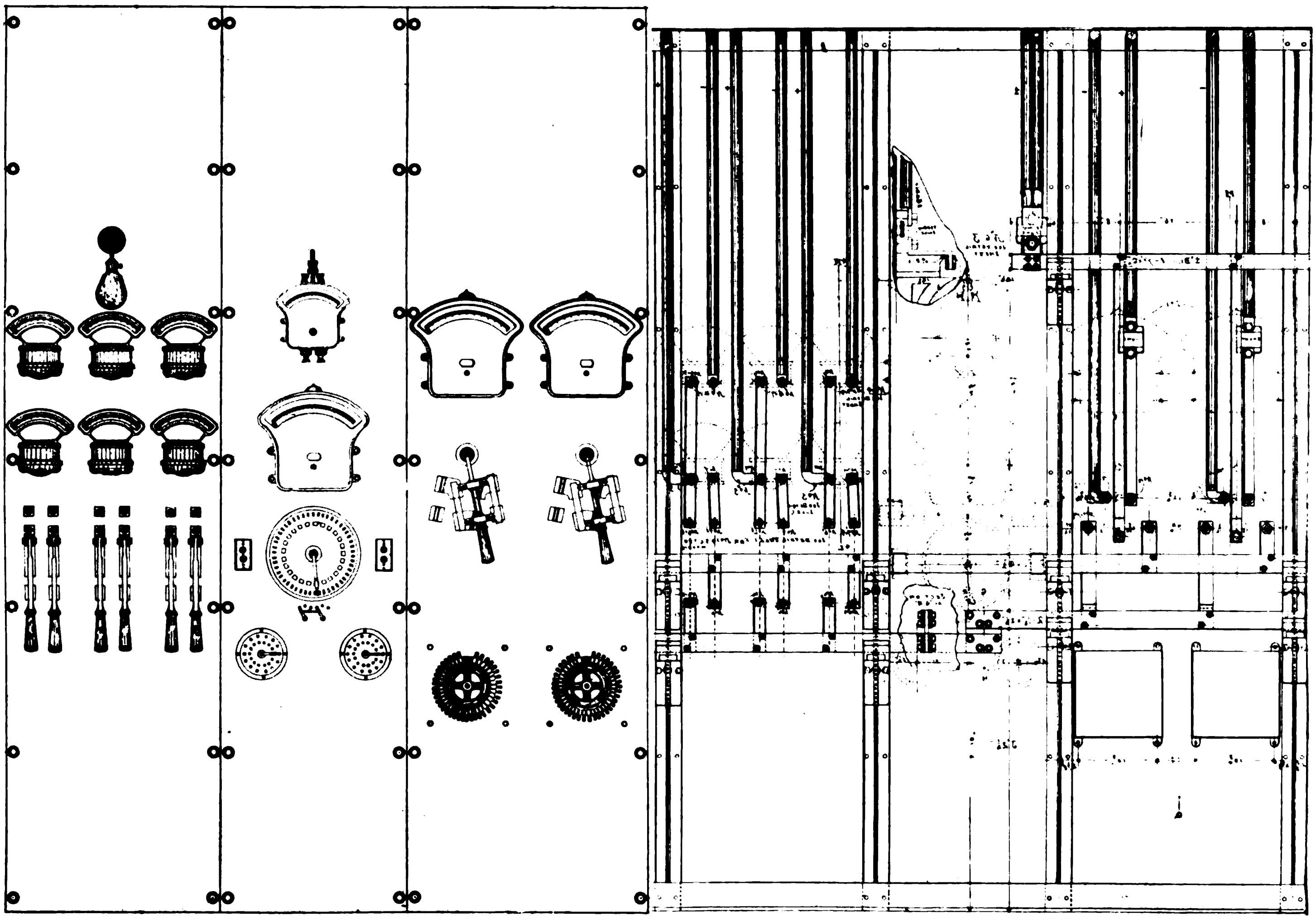


FIG. 5 & 6.—NEW NORTH SIDE STATION OF THE CHICAGO EDISON CO.—SWITCHBOARD FRONT AND REAR VIEW OF THREE PANELS.

The six districts covered by the mains of the Chicago Edison Company comprise all the more thickly settled residence and business portions of the city of Chicago. The company with its new stations and extensive systems of feeders and mains furnishes one of the great necessities in the life of the city. The officers of the company are men whose names have been for several years associated prominently with the electrical industry. The personnel of the company is as follows: President, Samuel Insull; vice-president, J. W. Doane; secretary and treasurer, F. S. Gorton; assistant secretary, C. H. Wilmerding; controller, W. M. Anthony; supervising engineer, Fredk. Sargent;

electrical engineer, L. A. Ferguson; superintendent of low tension apparatus, W. L. Church; superintendent of high tension apparatus, R. F. Kelsch. In the construction of the North Side station Mr. Insull has taken a personal interest. Mr. C. G. Y. King and Mr. E. H. Cheney of the engineering department are entitled to credit for the excellent manner in which the details of the installation have been designed and carried out.

Necrology—1893.

Nuttall, Robert D., born 1863, died August 29, 1893, was one of the organizers of the R. D. Nuttall Company of Allegheney, Pa., which was formed in 1887 for the manufacture of electrical goods.

Andrews, D. A., born 1835, died March 11, 1893, was a member of the well-known Pettingel-Andrews Company, of Boston, which for the past five years has taken an active part in the electrical trade of Boston.

Boardman, Samuel, born 1816, died March 14, 1893, was at the time of his death president of the Bishop Gutta Percha Co. of New York, the well-known manufacturers of insulated wire and cables. He was senior member of the law firm of Boardman & Boardman.

Meston, A. W., born Edinburgh, 1867, died St. Louis, 1893, was the inventor of the Meston motors and one of the founders of the Emerson Electric Mfg. Co. of St. Louis. He made a special study of the alternating current, and his work in that direction will be long remembered.

Stephenson, John, born July 4, 1809, died July 31, 1893, "a veteran car builder," having been intimately connected with the street railway interests for 65 years, or since the beginning of the industry. He was a public-spirited citizen and took a keen interest in everything of public importance.

Capen, Geo. D., born July 13, 1838, died May 1, 1893, was president of the Lindell Electric railway of St. Louis. He was prominent for a number of years in the street railway affairs of St. Louis, and under his direction the Lindell road rose from a small horse line to one of the largest roads of St. Louis.

Burnham, Louis W., born April 17, 1831, died August 9, 1893, was for ten years previous to his death actively engaged in the manufacture of electric gas lighting apparatus and electrical specialties. He was at the time of his death vice-president and general manager of the Electric Gas Lighting Co. of Boston.

Gordon, J. E. H., died March, 1893, was known through his works on electricity, among which were "A Physical Treatise on Electricity and Magnetism" and "Practical Treatise on Electric Lighting." He was educated at Eton and Cambridge and devoted his knowledge and energy to the introduction of electricity.

Upham, J. C., born 1838, died Nov. 2, 1893, for ten years electrician for the Commercial Cable Co. He was connected with a number of cable and telegraph companies during the 37 years of active work in this branch of the electrical industry. Great credit is due him for the hard work for the introduction of the duplex cable working.

Anderson, Sir James, born 1824, died May 7, 1893, was known most widely as the commander of the Great Eastern while the Atlantic cable was being laid. He took an active part in the laying of a number of cables and was a director of several companies. For his work in recovering and repairing cables in deep water he was knighted by the Queen. He was the author of several books on cables.

Reckenzaum, Anthony, born Graz, Austria, 1850, died London Nov. 11, 1893, was a prominent English electrical engineer, and gave special attention to the secondary or storage battery. He was for a time connected with the Faure Accumulator Company, and afterwards was electrical engineer of the Electrical Power Storage Company. In 1885 he opened an office in London as a consulting engineer. He contributed a number of articles to the technical papers.

Blake, Edward, born Nov. 3, 1862, died Oct. 10, 1893, lectured for several years before the Massachusetts Institute of Technology on electrical machinery. A graduate of the scientific department of Yale, supplemented by post graduates at Yale and Boston and an extended opportunity for observation, he was well versed in electricity and its applications. He was a pioneer in electric railway construction in New England, and was for some time New England agent for the Sprague Electric & Motor Co.

Pullman, Albert Benton, born at Auburn N.Y., Oct. 16, 1828, died Ingleside, Dec. 18, 1893, was for many years an active member of Pullman's Palace Car Co. He came to Chicago in 1860 and soon after became identified with his brother George M. Pullman in the construction of sleeping cars. In 1867 when the Pullman company was organized he was made superintendent and afterwards became second vice-president. For a number of years he had charge of the construction department and under his direction the first electric street cars built by the company were designed and constructed. He retired from the company a few years ago. Although in failing health his death was sudden and unexpected.

Green, Dr. Norvin, born 1818, died 1893, was president of the Western Union Telegraph Co. since 1878. A graduate of the University of Pennsylvania, he practiced medicine for several years in Louisville, but becoming interested in several telegraph lines in the south, made telegraphy a special study. Upon the consolidation of the American, United States and Western Union companies in 1873, he became vice-president of the consolidated company, and five years later, upon the death of Mr. Orton, was elected president. Dr. Green was one of the first members of the Am. Institute of Electrical Engineers, and served two terms as its president. His commanding figure, genial disposition and keen intellect made him a prominent figure in every gathering.

Goebel, Henry, born Hanover, Germany, April 20, 1818, died New York Dec. 4, 1893, came into prominence through his connection with the suits brought by the owners of Edison incandescent lamp patent against the alleged infringers. It was claimed by him that he made incandescent lamps as early as 1854 which involved the principal features of the Edison lamp. The defense known as the "Goebel defense" was employed in several of these suits. In the suit against the Columbian Lamp Co. before Judge Hallett, of St. Louis, it was pushed the hardest and was successful. Henry Goebel was a watchmaker by trade, but spent a great deal of time in experimenting with electricity and made many important discoveries. He was often seen in the vicinity of Union Square with a telescope and a number of electric lights fed by primary batteries. He charged a fee for looking through the telescope, and used the electric lights to attract a crowd. He remained practically in obscurity until a few months before his death.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

Advertising Rates upon application.

The growth and expansion of Electrical Industries has made it necessary for us to again seek new and larger quarters. We will therefore remove, about January 15, to rooms 1428–29–30, located on the same floor in the Monadnock Block, as at present. The new offices will give us the needed facilities, with considerable more space and a pleasanter outlook. We hope our friends will not fail to call on us in our new quarters as early and often as possible.

A significant sign of the times in respect to the future of the electric railway is seen in the important announcement made in another column that a large manufacturer of cable machinery at Cleveland, O., is to engage in the manufacture of electric railway apparatus. This well-known company, of which Mr. John Walker is manager, has been identified with cable railway manufacturing interests for many years and the fact that it is now to enter the field is a practical indorsement by its experts of the electric railway system. The move is a very important one and indicates the coming supremacy of electric traction.

Among the most interesting things of last month was the offer of a prize of $50,000 by the New York Metropolitan Traction Company for a street railway system superior to the trolley or cable. This offer will no doubt prove attractive and stimulate inventors to bring forward many new devices and systems. The New York Board of Railroad Commissioners were unable to accept the conditions as proposed but they have offered to co-operate with the Metropolitan company so far as possible. It is reported that that section of track on Fiftieth St. in New York City will be used for experimental purposes on which the different systems will be tried. The outcome of these experiments will be interesting to say the least.

The series of suits carried on by the General Electric Company against the alleged infringers of the Edison incandescent lamp patents has kept the subject prominently before the trade. Of the decisions so far reached in the suits the majority favor the General company but still no material advantage has been gained. New lamps have been produced so constructed as not to infringe the patents of the General company and the factories re-opened, in some cases with their capacities greatly increased. The recent announcement by the company of a reduction in the price of lamps has presented a new side of the subject. The Edison patents soon expire but as to the exact date there is some difference of opinion. In aly of the suits which have lately been commenced, the time is too short to reach a final decision before the patents expire and the question presents itself whether a new method is contemplated by the company of downing its competitors. About a year ago the Westinghouse company brought out a cheaper lamp and it is reported that the price will again be lowered. This competition will be to the advantage of the consumer in the reduced cost and to the advantage of the manufacturer in increasing the number of consumers. The number of isolated plants has increased to a large extent during the past year and as the cost of apparatus and renewals decreases the number of isolated plants will still further increase. The same reduction in cost has helped to introduce the incandescent lamp in factories, residences, etc., for which it is especially adapted.

We present in this number a description of one of the electric power houses of Great Falls, Montana. Admirably situated in the immediate vicinity of large water falls the city is supplied with an abundance of power for years to come. Probably in no city in proportion to its size is electricity used in such quantities nor for such a variety of purposes. Even with an abundance of coal near at hand the electric motor is found the cheaper form of power. The cost of power at Great Falls cannot be accurately compared with the cost of power in the east without taking into consideration the difference in the price of labor, the increased cost of the installation, repairs or renewals on account of the cost of transportation from the east. Its cost will decrease as the number of customers increases and the system of transmission is improved. Improvements are already contemplated for the incandescent lighting circuits by which the current will be distributed with a less percentage of loss. Whenever the demand shall warrant the construction of a power circuit separate from the railway circuit a large saving will no doubt be made in that direction. There are a number of neighboring towns which will undoubtedly soon be of sufficient importance to warrant the construction of feeder lines to them. This enormous water power near the center of the city is but partly developed and but a small part at present in use. It will attract the manufacturers and power users of that region and will undoubtedly create a manufacturing center as well as a mining center. The adoption of electricity as a means of transmitting and distributing power has given a new impetus to the development of water falls. Their power is never exhausted but varies only as the changing of the seasons which in places is overcome by nature and can be in many others overcome by the construction of higher dams making larger reservoirs. The systems of distribution are being improved so that the loss in transmission is greatly decreased which increases a corresponding amount, the value of the water right. The construction of a large number of long distance transmission plants is contemplated in different parts of the west during the coming year which indicate the great interest taken in this subject.

With this issue begins the fifth volume of Electrical Industries and while we are averse to sounding our own praises the record this journal has made is something we feel we can point to with much pride. The past year has been in many ways the most eventful one in the history of electricity. The World's Fair was of course the event of the year and served to bring into prominence probably more than anything else the growth and importance of the electrical industries. Certain it is that everyone who contributed to the success of the electrical features of the Fair has reason to feel proud of the grand exhibition. Electrical Industries, with its characteristic enterprise, undertook to give its readers the fullest possible information of what was transpiring at the Exposition. It was found at the beginning that it would be impossible to publish everything of interest as a matter of news in its regular monthly issue. Consequently during the period covered by the Exposition a 16-page weekly was issued. This sheet proved to be a most popular one and was received with great enthusiasm by our readers from one end of the country to the other. During the recent depression in the financial world the electrical business has suffered with the rest. This journal, however, takes much credit to itself in the fact that there was very little decrease in its advertising patronage while its subscription list grew continuously. Its editorial pages have been kept up to the high standard of excellence which it has always maintained in spite of the general depression in the trade. For past favors we thank our many friends and for the year 1894 we wish them all a happy and prosperous season. During the coming year several new features will be added to the paper and its field greatly extended. Special departments that will be of great interest and importance to practical men will be opened. With greater facilities for the production of illustrations that feature will be improved. We are sure our readers will appreciate the paper the present year more than ever and will recommend it to their friends. Our subscription list will thus increase in the same generous ratio as in the past.

An ingenious device for securing the greatest amount of light from a given supply of electricity has recently been devised by Mr. S. L. Trippe, of New York City. The principle involved is very simple and consists in turning the current in succession on to a number of circuits on which the lamps to be lighted are distributed. As it is turned on one circuit, it is turned off from the preceding, but before any filament has had time to cool, the current will again be on. The Electrical World thus describes the device which has been patented by Mr. Trippe. "The means by which this is accomplished is the employment of a special interrupter or rotating cylinder, on which the segments are so arranged that a system of brushes, with which they make contact, carries the current alternately to each series of lamps. It is evident that the period of its current or the number of times per second which passes through a given set of lamps can be made almost anything, depending upon the construction of the interrupter and its number of revolutions. In this device it was somewhere about 70 per second. The induction currents are utilized in feeding a separate circuit of a few lamps, which, it is claimed also serves to prevent sparking. The loss of energy in the commutating or interrupting device is, of course, to be considered, but Mr. Trippe claims that between two and three times as many lamps can be operated from a given source of energy as with any of the other systems in use to-day. The interrupter can be run by a steam engine, a motor or any other source of power. The system has been experimentally tried in one of the largest buildings in New York City, and as it was necessary to largely increase the capacity of the plant there installed it has been decided to introduce the invention of Mr. Trippe. The result of the experiment will be watched with interest, as the only true way to test the merits of any system is to subject it to the varying conditions of practical, every-day use."

Electricity at the California Mid-Winter Fair.

W. F. C. Hasson

The electrical display will form one of the most attractive features of the California Mid-Winter Fair. Previous experience has shown what electricity can do in the way of lighting and decorating, and the plans for the electric lighting of the grounds and buildings now nearing completion have been carefully made with a view to producing the best effect. Mr. W. F. C. Hasson, who is at the head of the department of electricity, has had an extended experience in the different branches of the electrical industry. His education was received in one of those schools from which so many young men have gone forth and worked themselves into positions of prominence. After graduating from the Naval Academy in 1880 he spent several years alternately in land and sea duty. In 1889 he was ordered to John Hopkins' University, where he assisted Dr. Louis Duncan in the development of the course in electrical engineering.

Having made a careful study of the long distance transmission of electric power he resigned from the Naval service in February, 1892, and sought a wider field where he could make use of his experience and study. He went to California and opened an office as consulting electrical engineer. He has been retained on a number of important installations, and is at the present time engaged on the Folsom-Sacramento transmission, which contemplates the transmission of 3,000-horse power a distance of 20 miles. In the formation and construction of the Mid-Winter Fair, Mr. Hasson has taken an active part.

Electricity will occupy the position at the Fair, which its industrial importance entitles it. The electrical exhibits are being placed in the Mechanical Arts Building, shown in the accompanying cut. The building was designed by Edwin R. Swain, and is 160 by 324 feet.. The lighting of the grounds and buildings will be done by exhibitors, the lighting plant being considered as an exhibit. The General Electric Company, the Standard Electric Company, the Western Electric Company and the Fort Wayne Electric Company are each installing exhibition plants. These plants will furnish 1,000 arc lights and 15,000 incandescent for the buildings and grounds, besides lights which will be furnished to exhibitors and others for special decorations and illuminations. The incandescent lighting will be done by three different systems: 500-volt series for out-door decoration, alternating current transmitted at high voltage and reduced by transformers for the remote concessions and the 110-volt continuous current multiple system.

The exhibits so far installed and for which space has been assigned indicates that the exhibits will represent the different electrical machines and apparatus in practical use. The Western Electric Company is making a display of the extensive line of goods manufactured by it. The General Electric Company, besides its exhibit of lighting apparatus, displays mining, railway and electric power machinery. The company is also putting in an electric fountain which is located in an advantageous position and will form one of the special attractions of the evenings at the Fair.

The central attraction of the Fair will be the electric tower which stands 266 feet high in the center of the court or plaza, around which the principal buildings are grouped. The Western Electric Company, to whom the contract was awarded for lighting the tower are at work on the wiring. There will be 2,000 lights used which will be arranged in changing colors and figures, the designs of which will be changed as the Fair progresses. In the large globe which surmounts the tower is a large search light which will be operated by the General Electric Co. An elevator will convey visitors to various galleries on the tower, from which an excellent view may be had of the surrounding country. At the base of the tower are four Moorish pavilions, divided into several stories one of which will be used for a band stand. The accompanying cut shows the general plan of the tower.

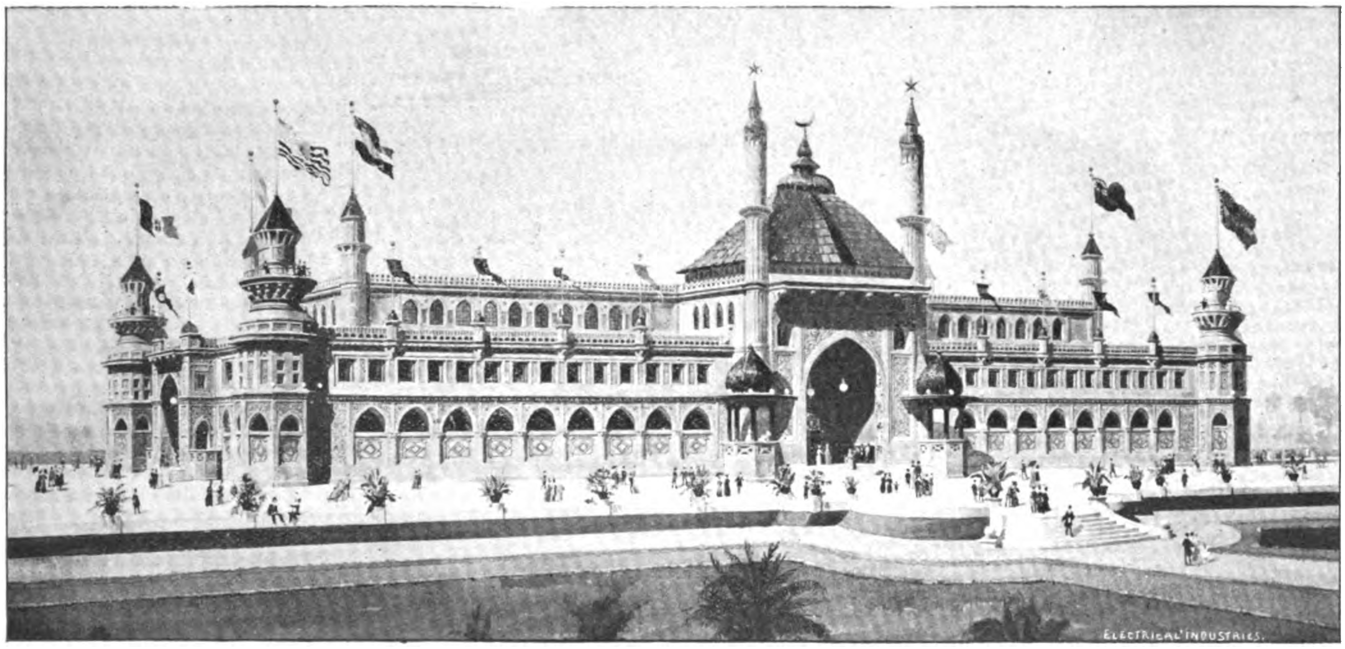
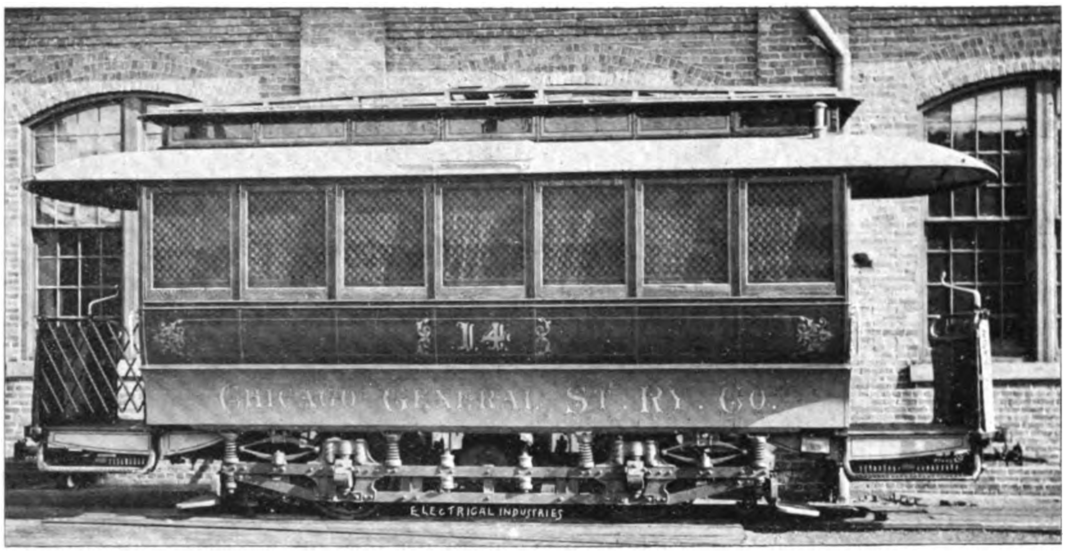

ELECTRICAL INDUSTRIES.

FIG. 1.—ELECTRICITY AT THE CALIFORNIA MID-WINTER FAIR—MECHANICAL ARTS BUILDING.

The influence of the Fair has been constantly extending so that not only are the western states interested, but also Mexico, the states of Central America and also the islands of the Pacific.

The Chicago General Street Railway.



THE CHICAGO GENERAL STREET RAILWAY.

In order to supply the many residents of the district lying between 22nd. St., Crawford Ave., the river and the city limits with means of transportation, The Chicago General Street Railway Co., was incorporated. Its authorized capital stock is three million dollars of which $500,000 has been issued and bonds to the amount of $100,000 sold. The officers of the company are, president L. E. McGann, vice-president and purchasing agent C. L. Bonney, secretary and treasurer Lawton C. Bonney.

The franchises of the company cover the territory named above for which it will require about 20 miles of track. The company now has nine miles of track built and extensions will be made gradually until the district is covered. The road is standard gauge and the rails are Pennsylvania Steel Co's. seven inch 80-pound girder laid on sawed white oak ties. The rolling stock is to be of the best. The five motor cars now in use are as neat, substantial and commodious as can be built. They were built by Pullman's

Palace Car Co., and are well shown in the accompanying illustration. The bodies are 18 feet long with four foot platforms. There are seven windows on each side fitted with Hartshorn roller curtains. The interior finish is quartered oak with threeply birdseye maple ceiling. The ornaments are of aluminum. The seats are rattan over Hale & Kilburn's springs and will accomodate 26 persons. The car is also equipped with a standard heater, Everitt floor matting and is lighted by electric lights. The platforms which are broad are furnished with folding gates, rotary foot gongs, Stanwood insulated steel steps and Lester & Co's. headlight. They are mounted on a Peckham No. 6,B cantilever trucks with a wheel base seven feet six inches and 30-inch wheels. The grab handles, brakes handles, etc., are of bronze. Each motor car is equipped with one 35-horse power Sperry whaleback motor geared to both axles. The company are well pleased with this style of motor and report that during the recent snow storms there was no trouble with their operation, the regular schedule being maintained. Ten trail cars and five additional motor cars will be completed and placed on the road by April 1st.

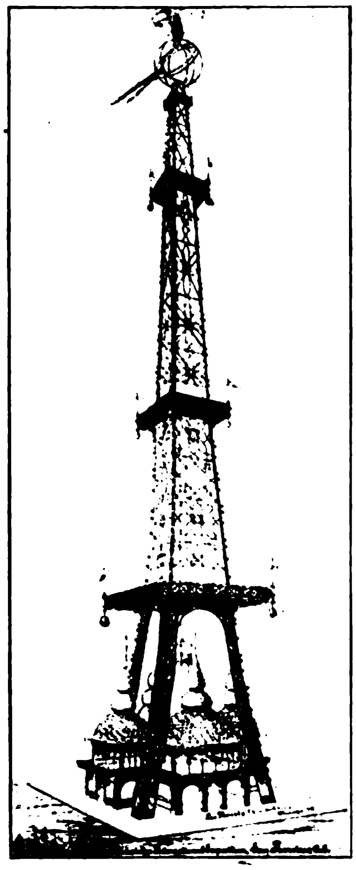


FIG. 2.—ELECTRICITY AT THE MID-WINTER FAIR.

The Walker Manufacturing Co.

The manufacture of electrical machinery and apparatus now ranks as one of the most important of the productive industries. The field has been gradually extending until there is scarcely a town but has its lighting plants, while among the larger towns the electric lighting, electric railway systems and systems of power distribution form important industries. The use of the electric system of transmitting power through factories and manufacturing works has also increased the demand for electric machinery. The construction of large generating stations from which the electric power is transmitted and distributed to the consumer has created a demand for large and special forms of machinery.

In adding this line of products to its already extensive manufactures the Walker Mfg. Co., of Cleveland, Ohio, which, for many years has held a prominent place among the larger manufacturers of machinery will still further extend its trade and place an important and well equipped factory at the disposal of users of electrical machinery. The company has been so long and so prominently known especially to the street railway interests that it needs no introduction to our readers but perhaps a description of its extensive works may be of interest. Their location probably could not be improved. Being near the center of population with every facility for the reception of the raw material and for the distribution of the manufactured products. Switches and sidings at the works afford every facility for quickly receiving and delivering freight.

The buildings are constructed with special reference to the requirements of the company, the experience of the designers enabling them to arrange them to the best advantage for handling economically the material during the process of manufacture. For handling heavy castings the foundry and machine shops are well equipped. In the manufacture of the larger units which are being used more extensively at the present time larger castings are required. In this direction nothing is wanting in the foundry. The building, which is 300 feet long and 118 feet wide, is built in three bays. The center one is 57 feet in width and 41 feet high. Heavy girders run the entire length on each side the bay and carry two 30-ton traveling cranes. The two side bays are equipped with 12-ton cranes. Everything here is prepared for heavy castings. The tools and machines are such as handle safely and quickly the heavy castings required in the machinery manufactured.

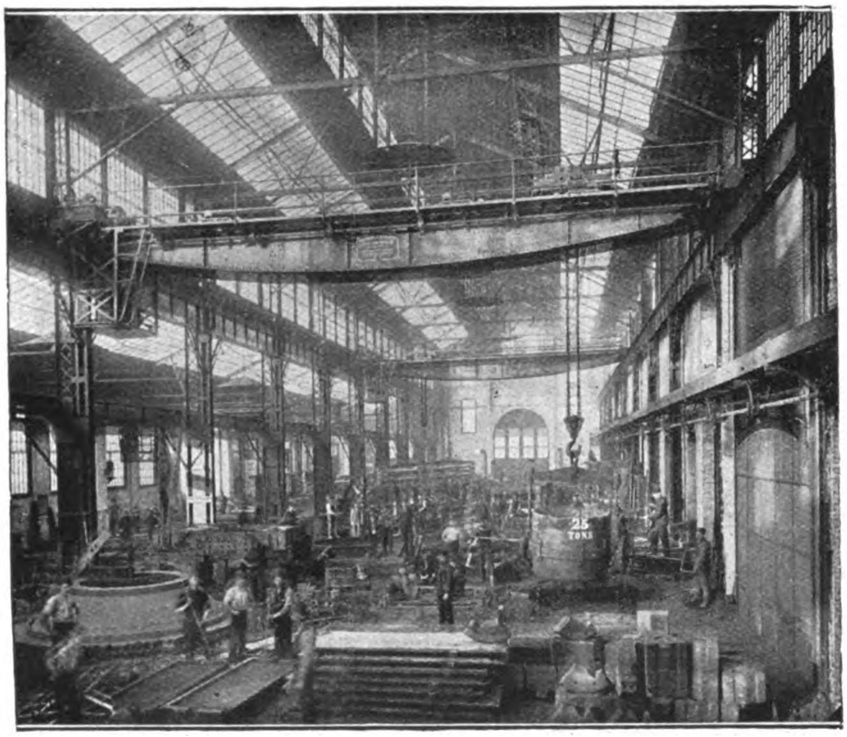


FIG. 1.—THE WALKER MANUFACTURING CO.

The roof is abundantly supplied with skylights and means of ventilation. The cupolas are of an improved design and give most economical results. An average of 13.1 pounds of iron per pound of coke has been secured on an average. The cupolas are equipped with hoisting apparatus for elevating the material to the mouth of the cupola and have a capacity of 80 tons of metal per hour. Hydraulic machinery breaks the metal and operates the elevating apparatus. A three-cylinder vertical blowing engine furnished air to the furnace. Casting pits of various sizes are located about the foundry. The ladles carried by the cranes vary in size from 3 to 25 tons.

While the facilities for large castings are of the best, the making of small castings has received no less attention. A foundry building, 58 by 200 feet, adjoins the larger building and the same cupolas are used as in the larger. The castings are thus, whether large or small, of the same character and uniform. The core ovens are of special pattern, supplied with the latest styles of carriages and means of operating. These are respectively 24 by 30 feet, 20 by 30 feet and 18 by 25 feet in size.

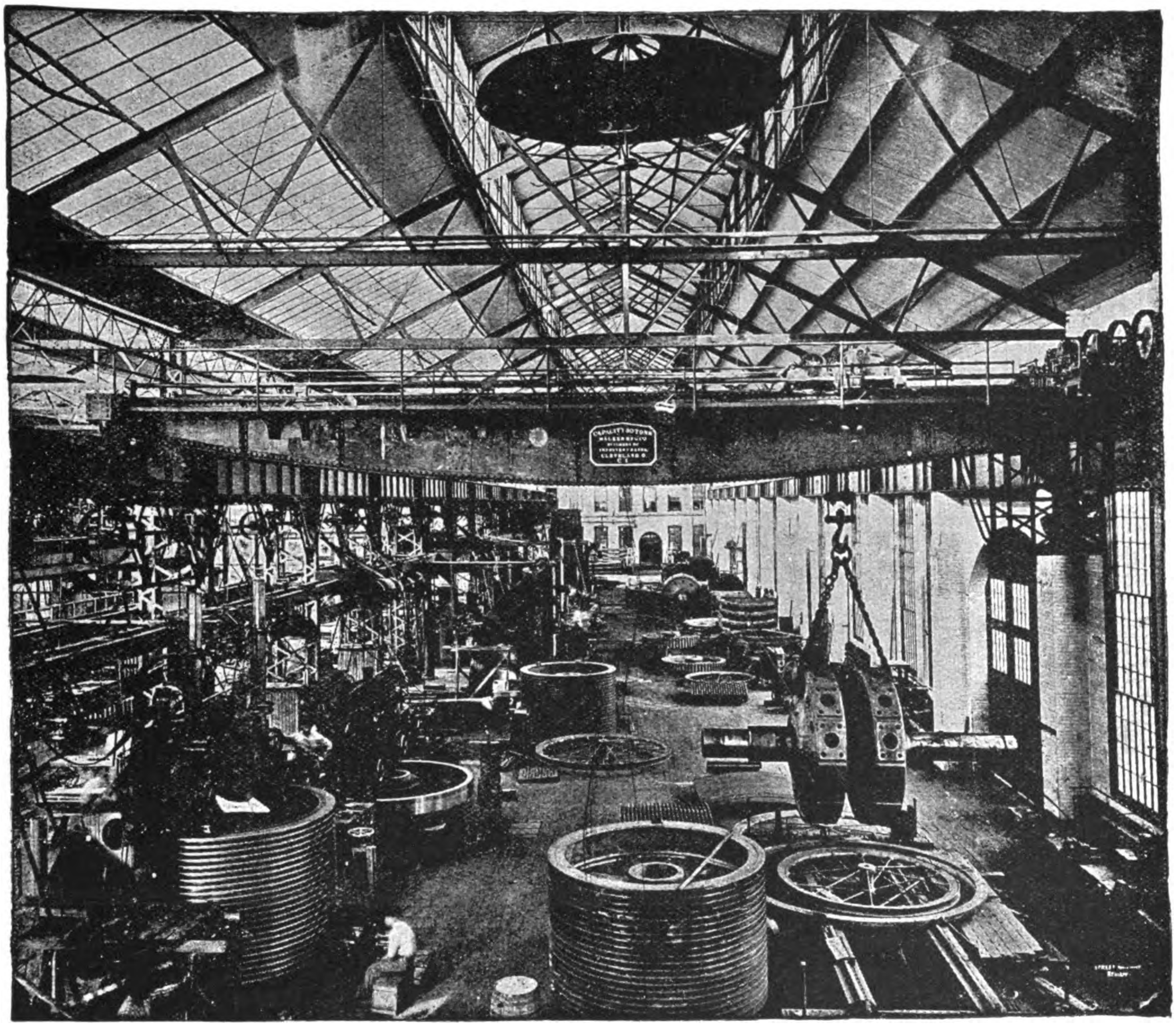


FIG. 2.—THE WALKER MANUFACTURING CO.

The machine shop is built and equipped on the same large plan. The building is 171 feet wide, divided into three bays, one of which is 430 feet long and the others 280 feet. Thirty ton traveling cranes convey the heavy castings from one machine to another, or lift them from the cars which run within the building. Scales for weighing shipments are placed at convenient places. In bay A where the fitting and erecting is done, the special tools and machines used in that department are placed.

In bay B are arranged the large lathes, planes, and boring machines. One of the floor boring and milling machines has a capacity of 14 feet horizontal, 6-foot vertical lift and a 6-foot feed horizontal. It is equipped with a planer 25 feet by 10 by 10, and uses when desired four tools. In bay C the gears and pulleys are cut. The equipment includes a 10-foot Gleason gear planer capable of cutting gears with a 30-inch face, boring mills ranging in size from 7 to 24 feet, an immense pit lathe with girders 90 feet long for turning the larger gears and pulleys. Pulleys of 104 tons weight have been turned in this lathe. There are also provided at these works which cover 13½ acres of ground, store rooms, pattern rooms, offices and drafting rooms, to which will be added accomodations for the manufacture of special parts of the electric machines.

The men at the head of the company have long held a prominent place in the financial world, the engineers of the company have produced machinery which in mechanical construction has successfully met the competition of engineers in all parts of the world. The new policy of the company has brought to it Mr. H. L. Harding, of New York, and Mr. J. L. Barclay of Chicago, both of whom are well known in the electric railway field. They were formerly connected with the Sprague company, and more recently with the Westinghouse. Mr. Harding will represent the Walker company in the East, and Mr. Barclay will represent it in the West with an office in Chicago.

Electric Haulage in Mines.*

BY RUFUS J. FOSTER.

The mines of the Brock Coal Co., consist of five drift openings in a hillside about half a mile southeast of the town of Brockwayville, Jefferson county, Pa. But four of these drifts are in operation, viz., Nos. 1, 3, 4 and 5. The seam of coal worked averages about 31 inches thick. In some places it is as much as 42 inches thick, and at others it is pinched out entirely. The present production of the four drifts ranges from 300 to 400 tons per day. The inclination of the seam is very slight, being merely enough to insure natural drainage for about five inches in 100 feet. This dip is very regular. The seam has a hard sandstone top and a soft fire clay bottom.

The coal produced is delivered at two different points. That for shipment is delivered to chutes on the Brock Coal Co.'s branch railroad, and from them loaded into railroad cars. The balance goes to chutes on the Ridgway and Clearfield branch of the Phila. & Erie R. R., and is taken from them by the railroad company for locomotive use.

The outside tramway connecting the four drifts with the two sets of chutes is about one mile in length. It runs along the hillside and is constructed of 25-lb. T rail. The gauge of the track is 30 inches.

Fig. 1 shows a plan of the outside road, the location of the chutes, drift mouths, power house, the outcrop of the seam, the trolley wire, and the insulated relay wire. The relay wire is insulated copper wire No. 00 of Brown and Sharpe's gauge, and the trolley wire is a bare copper wire of No. 0, B. & S. gauge. The relay wire runs from the power house across the tracks to a point on the hillside above the tracks, and thence to No. 5 Drift. The trolley wire runs along the upper side and close to the track. The natural conditions existing along the side hill were very favorable, and the road was cheaply and easily constructed. All material for embankment and fills being taken from the side cut in the hill.

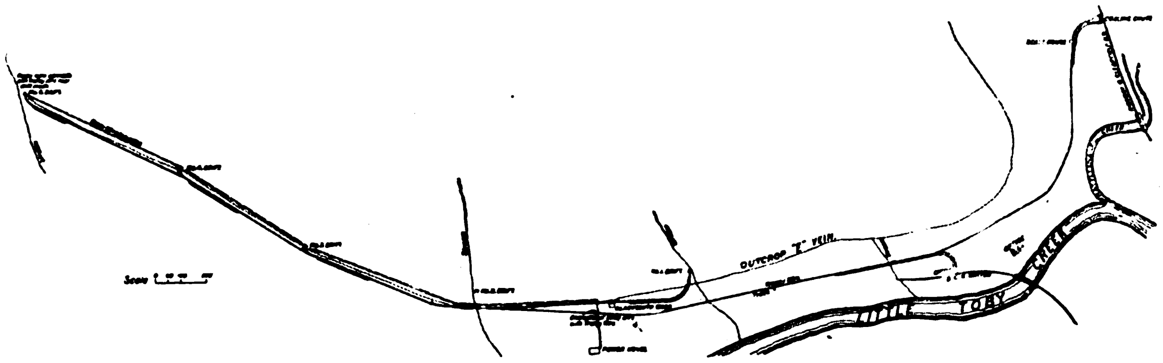


FIG. 1.—ELECTRIC HAULAGE IN MINES.

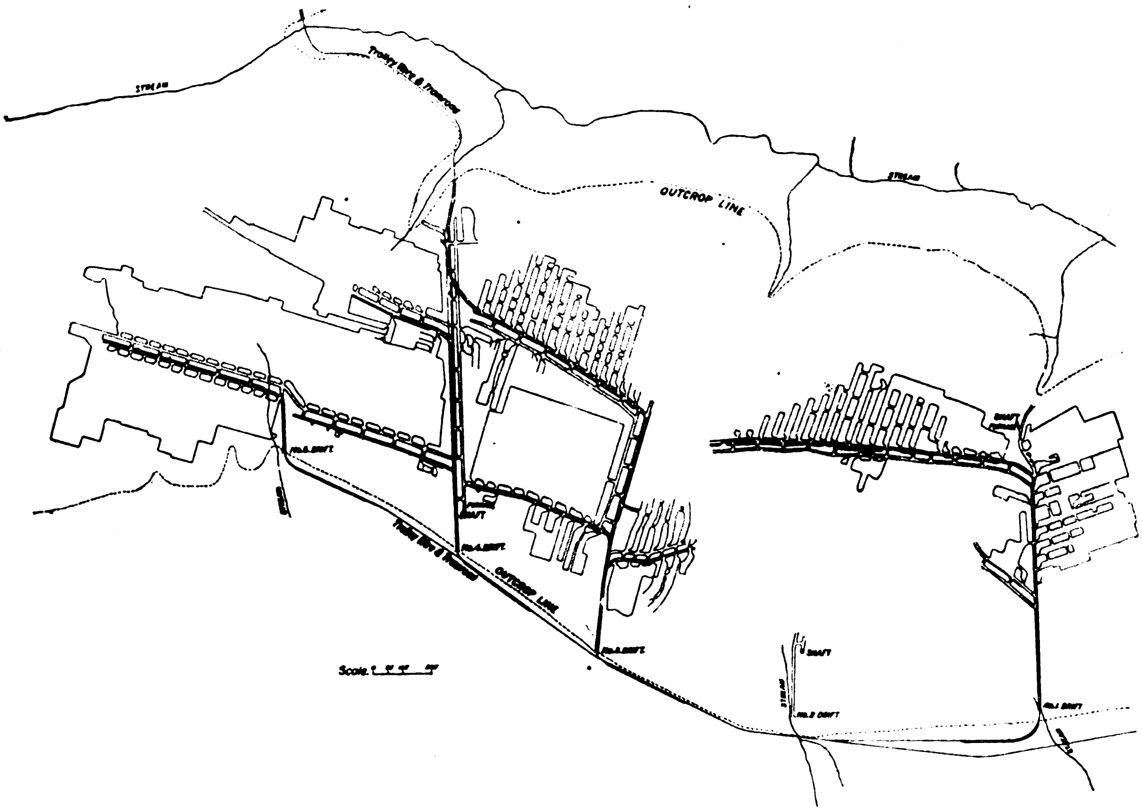


FIG. 2.—ELECTRIC HAULAGE IN MINES.

However, it was desirable to have a substantial, economical and convenient system of haulage suitable for a track laid with light rails running in headings or gangways where mule haulage was impossible unless excessively large quantities of the fire-clay bottom were taken up. Electric haulage was deemed the best for the existing conditions, and the contract for the two locomotives and the entire plant was given the General Electric Co.

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*Abstract.

In fig. 3 *a* represents the sills, which do not differ from ordinary sills used on small roads. The switch lever is shown at *b*. The posts for supporting the trolley wire are marked *c*, the beams carrying the insulating cups, *h*, are marked *d* and the braces running from the posts to the beams are marked *e*. The trolley wire is marked *f* and the straining posts *c g*.

As we mentioned before, the great difficulty to be met with was the fact that the size of the seam made it necessary to take up bottom so as to get height enough in the main haulage roads. If mules were used this removal of the fire-clay bottom meant, for a mine as extensive as the one under consideration, a very heavy increase in the cost of production. Mule haulage was adopted at first, but this plan required the taking up of from three to four feet of the bottom. By reference to Fig. 2 it will be seen that the several drifts are worked on the pillar and stall system, and that the inside haulage roads are extensive. These roads now traversed by the electric locomotives are shown by dotted lines.

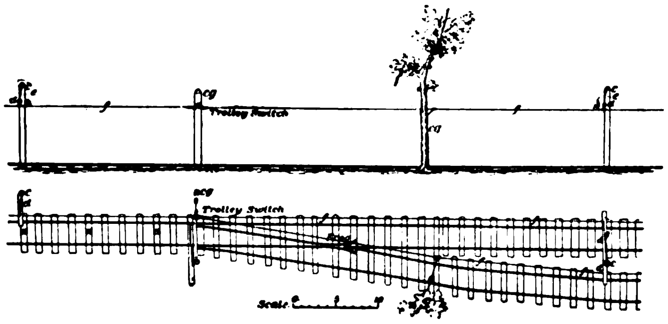


FIG. 3.—ELECTRIC HAULAGE IN MINES.

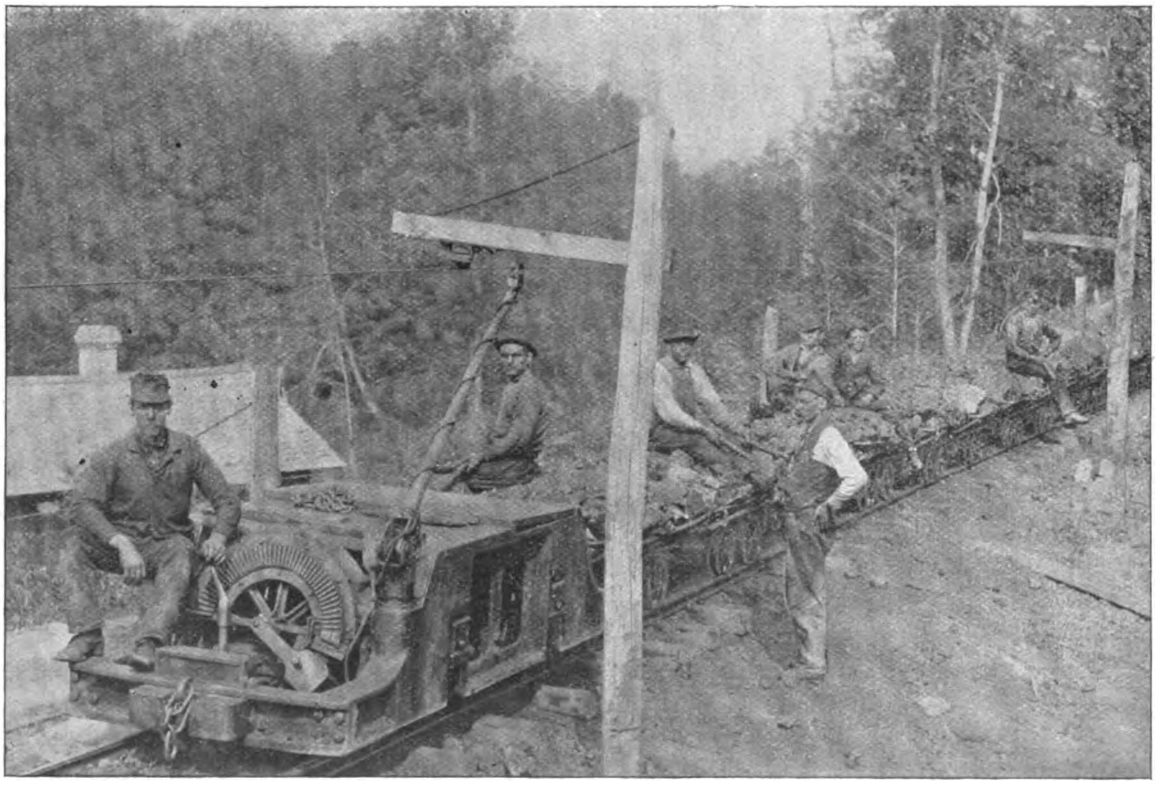


FIG. 4.—ELECTRIC HAULAGE IN MINES

Fig. 5 shows a section of the haulage roads as they are now constructed, and shows that comparatively little of the fire-clay is now taken up, or in other words, but little more than half as much as when mules were used. The rails used inside are 20-pound T rails, and the trolley wire is suspended from the roof, as shown in Fig. 5, though in most instances it is over the ditch instead of being on the high side as it is at the point where the section was taken.

The inside grades are very regular and are about five inches in 100 feet in favor of the load. There are no extraordinarily sharp curves, if the roads are considered as mine roads, but as usual in mines they are all curves that would be considered of very small radius on the surface.

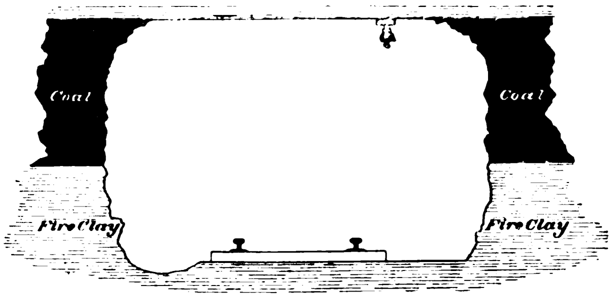


FIG. 5.—ELECTRIC HAULAGE IN MINES.

Two locomotives are used, each of the same type and capacity. Fig. 7 shows one locomotive with a loaded trip These locomotives designed and built by the General Electric Co., are known as T. M. M., the locomotives of 1,500 pounds draw-bar pull each. They are each of the following dimensions: 32 inches high, 48 inches wide and 9 feet 6 inches long. The wheels are 30 inches, and the axles $3\frac{3}{8}$ inches in diameter. The wheel base, which is rigid, is 42 inches. Each locomotive weighs about 9,500 lbs., and has two motors of the new iron-clad street railway type equipped with four-pole Gramme ring-toothed armatures. The armatures are series connected so as to use only two brushes each, and these are on the upper side of the commutator and in an easily accessible position. The armatures are connected with the axles by machine cut single reduction gears running in gear cases filled with oil. The frames are of cast steel and of such shape as to thoroughly protect the spools and armatures, which are thoroughly water-proofed. The trolley arms are supplied with universal joints so that they accommodate themselves to any position required by the location of the trolley wire.

Power is furnished the locomotives from a Thomson-Houston D 40-220 volt generator run by an old style McEwen engine of about 80 horse power.

In speaking of the work of the locomotives Mr. Robert Dick, superintendent of the mine, says:

"They are doing good work and have entirely replaced the mules. Each locomotive leaves the chutes with its train of 26 empty cars and when the live workings are reached drops them at the various working places. It then returns, picking up loaded cars one by one, and at some points two at a time, and returns with them to the chutes every 40 minutes. The 26 loaded cars will average 20 tons of coal."

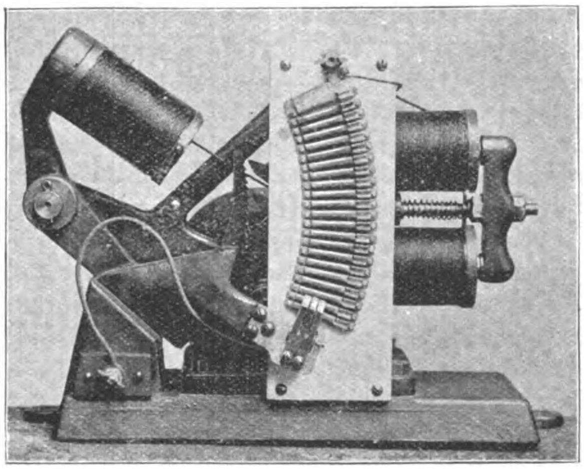


FIG. 1.—NEW AUTOMATIC MOTOR STARTER.

Dynamometer tests made on one of the locomotives showed a steady draw-bar pull of 2,700 pounds, or nearly 100 per cent. overload. Whether this pull could be depended upon for any great length of time is doubtful, as it naturally pulled the speed of the machine down very appreciably. However, it showed that the 1,500 pounds draw-bar pull can be largely increased with safety. As the engine is of much greater horse power than is actually required, the officials of the company are talking of coupling to it another 40 K. W. dynamo (which they have on hand), so as to gain more power to be utilized in the locomotives. The speed of the locomotives is eight miles per hour.

The locomotives are not only compact and convenient to handle, but are also very strongly built. All working parts are protected,but are at the same time easy of access. The wheel base is necessarily short to enable them to run around sharp curves, and as the mine rails are light, too much weight could not be put in them so as to increase the traction. The mine cars used are of the ordinary type used in bituminous coal mines working small seams. They have plain 11-inch wheels running on 1½-inch axles. The wheel base is 20 inches, and the capacity of each car is about 1,650 pounds.

The crew employed with each locomotive consists of a motor man at $2 per day and a boy spragger at $1.25 per day.

The success of these locomotives, is remarkable. Mr. Burr E. Cartwright, President of the Brock Coal Co., in testifying to the success of this haulage plant, says:

"In the two months of March and April, 1893, after the electric traction system was fully installed and in operation, the figures appear as follows: Total cost of producing coal, less regular fixed charges, as stated in regard to the first period, $11,495.94. The number of tons produced was 15,415.29, showing a cost per ton of $0.74576. Comparing this cost per ton with the previous figures of the first period, shows a reduction in cost in this period of $0.09102 per ton. I regard the operation of the electrical apparatus as very satisfactory in every respect, and I intend to introduce it wherever opportunity occurs in our mining interests."

This testimony of Cartwright's was made in June last, and is corroborated by the statements of Mr. Robert Dick, superintendent of the mine, made during the past month. The figures given do not calculate in the cost of mule haulage, the expense of keeping the mules when the mine is idle. The cost of the electric plant at such times is nothing.

New Automatic Motor Starters.

In the new applications of electricity devices are constantly being devised to meet the new requirements, probably no application of electric power has made a greater advance than that of the electric elevator. One of the greatest difficulties met was in the regulation of the motor. Being usually run by men unacquainted with the mechanical features of the elevator the controlling device must necessarily be positive in action and simple in operation.

In 1889 a device was brought out by the Automatic Switch Company of Baltimore, Md., for automatically starting the motor. With experience gained in the practical operation of electrical elevators the devices have been perfected and the automatic reversible starter and the automatic non-reversible starter shown in the accompanying cuts have recently been placed on the market. In Fig. 1 is shown the automatic reversible starter. The eccentric driven either by direct connection to the armature shaft of the motor or by a belt from a pulley on the commutator end of the armature shaft. The magnets are energised by the same current which starts the motor and at the instant the magnets are energised, the pawl and ratchet, which are operated by the eccentric, engage a series of teeth which form part of the lever controlling the resistance of the starter. The lever has only a sufficient number of teeth to cause it to be moved over the resistance contacts and the pawl works free after the resistance is cut out, while the ratchet retains the lever in this position during the run of the motor. Interruptions of the current from any cause releases the pawl and ratchet and the lever falls by its own weight to the point of greatest resistance.

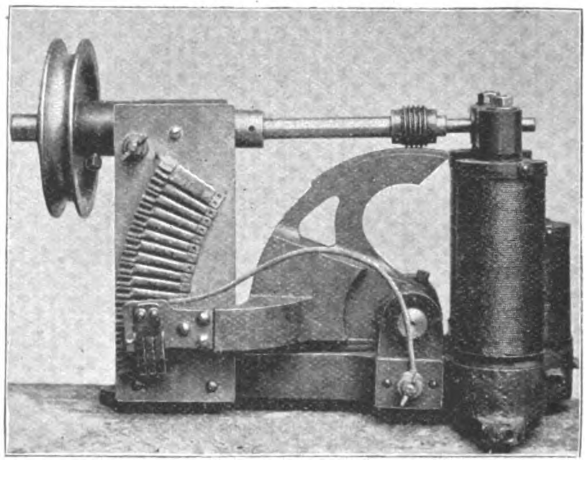


FIG. 2.—NEW AUTOMATIC MOTOR STARTER.

Fig. 2 shows a non-reversible starter for use with motors running in but one direction and it differs from the above in that it is operated by a worm controlled by magnets connected in the motor circuit the worm being driven by the motor or any suitable power. This motor starter is especially applicable to pumping and pressure tank work. These starters, as will be seen from their construction, are capable of handling motors of any horse power. The method of starting prevents the full current to be thrown on untill the fields are fully saturated.

A New Automatic Fire Alarm System.

The work required of a reliable automatic fire alarm system is of such a peculiar character that to devise a perfect system involves many difficult problems. To remain inactive through long periods, but be ready to act at the instant required, demands a durable, well insulated system, and one which is at all times sensitive to the presence of fire. Another important feature of such a system is that should it at any time be disabled the fact will be automatically announced.

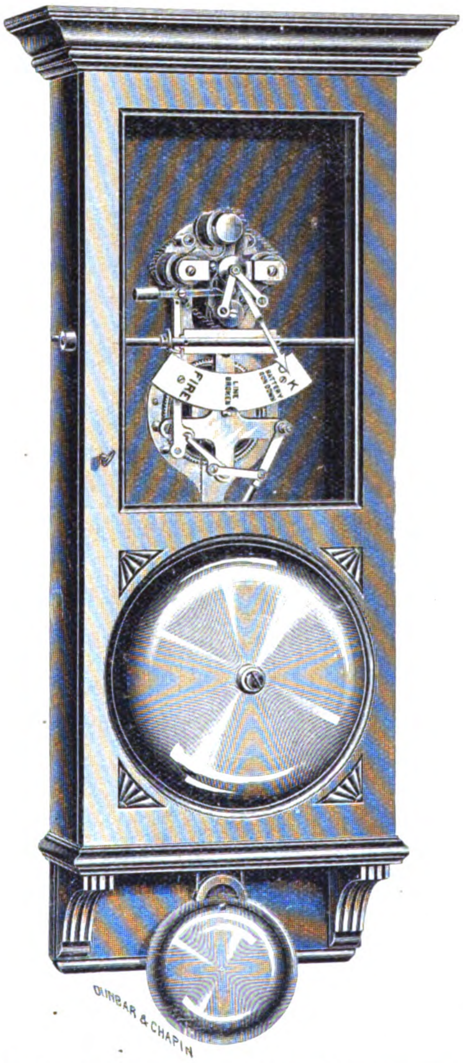


FIG. 1.—NEW AUTOMATIC FIRE ALARM SYSTEM.

It is also important that the latter announcement shall differ from the alarm of fire, so that the two signals shall not be confused. To accomplish this it is necessary that the thermostat in acting shall make some change in the line which is never made by accident. The receiving instruments should indicate the change that has taken place. In the system described here the thermostat in acting reverses the current instead of stopping it, a change that does not occur by accident. The receiving instruments will not indicate fire unless a thermostat has acted The receiving instrument, as shown in the accompanying cut, consists of a simple and reliable electro-mechanical gong controlled by a polarized armature of the rotary type. To this armature is attached a pointer, moving over a suitable dial arranged to show the change that has occurred, O.K., battery run down, line broken, fire. The armature and magnet are of a new design, which give a wide swing to the pointer with very little current. The common gravity battery is used, and thus the cost of maintenance is kept very low. The armature is brought to center by small weights, which with long practice have been found more reliable. The variations in the strength of the battery current do not affect the operation of the system.

The receiving instruments can be arranged with two bells—one eight inches in diameter, to be placed in the engine house to ring for fire only, and one of small size to indicate trouble on the line. The bells are also arranged to strike one blow for trouble on the line and to ring continuously for fire. One of the most important parts of every system of this kind is the thermostat. The one used is of a new design. It is strongly built, with porcelain base, on the lower side of which are clamped two bronze springs, which are held under tension by a fusible solder. A plate of vulcanized fibre is fastened to the upper surface, by which it is fastened to the ceiling. In the center of the porcelain base, and covered by the fibre plate, is molded a cavity that contains contact points, which are brought into action when the springs are released. The direct of the current is changed by the breaking of the old circuit by the melting of the fusible solder and reversed by means of the new connections.

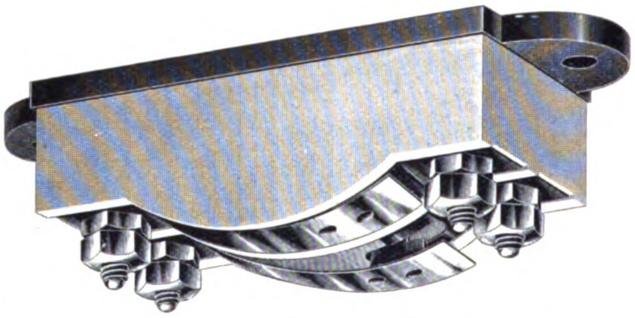


FIG. 2.—NEW AUTOMATIC FIRE ALARM SYSTEM.

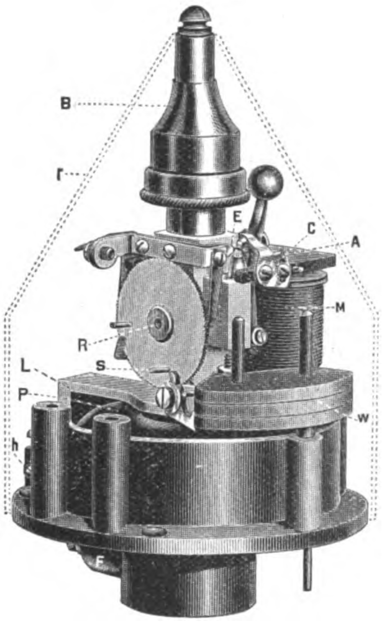
Should the battery run down, the small weights will bring the pointer to the point marked "Battery run down"; the striking mechanism would be unlocked and the bell would be struck. The attendant would at once see the nature of the alarm, and by turning a small handle on the left side of the case throws up a card marked "Disconnected." Under these conditions the system would still sound an alarm of fire unless allowed to stand too long. In case of a broken line or short circuit the same thing takes place, except that the indicator points to a different place. When an alarm of fire is sounded, the gong rings until turned off.

This system was devised by Mr. Gilman W. Brown, of West Newbury, Mass., who has spent a number of years in perfecting the details of the system. It is without relays and local circuits, and is much simpler than the older forms. No mechanical testing devices are used to complicate the system. Evidence of defects in the operation are automatically announced, rendering such additions unnecessary.

A New System of Lighting and Extinguishing Street Gas Lamps.

A system of lighting and extinguishing street gas lamps from a central point without the use of overhead or underground wires is a decided departure in street lighting. The Cutler system employs a small gas lighting outfit at each gas lamp which is operated by increasing the pressure of the gas in the mains acting similarly to the pressure of the button in the gas lighting system as usually installed. The mechanism is exceedingly simple and is substantial, not liable to get out of order.

Each lamp is supplied with two salammoniac batteries and a spark coil placed in an iron box buried in the ground at the foot of the post. These are connected with the burner in the lamp by two wires. The burner is shown in detail in the accompanying cut. A minature gas holder of about two cubic inches capacity forms an important part of the mechanism. Just above this holder is a gas lighter of the ordinary kind except that it is larger and stronger. When it is desired to light the lamps of a city, it is only necessary to open the valve connecting one of the large gas holders at the works direct with the gas mains. This causes an increase of pressure throughout the district supplied by the works sufficient to cause all the little gas holders in the lamp posts to lift up about one-eighth of an inch against a platinum stop and thus close the local battery circuit at each post.



NEW SYSTEM OF LIGHTING AND EXTINGUISHING STREET GAS LAMPS.

The cut is about two-thirds full size. At P is the gas holder sealed with mercury and held down by the weights W. When the gauge lifts the circuit is closed through the magnet, M. The amature is made to vibrate and cause sparks to fly between the tips and the ratchet wheel to turn. The small jet at E is first lighted and shoots up and lights the main jet. As the wheel turns the gas is turned off from the small jet. When the gas is on full the wheel stops by the pin in the wheel striking against the stop, S, attached to the pressure gauge.

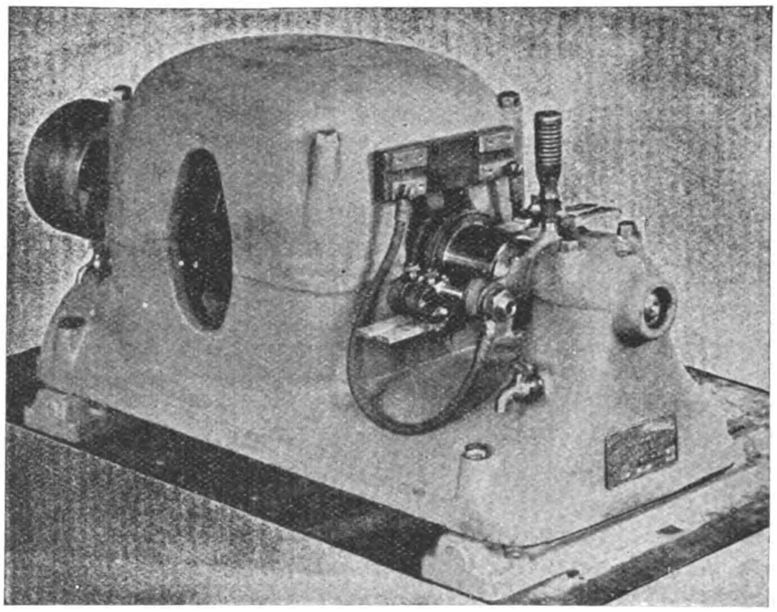
It has been shown in practice that 15 seconds is amply sufficient for maintaining this increased pressure to give time to make the increase everywhere felt. It can then be brought back to nominal pressure, when the pressure gauge will drop back and open the electric circuit. This operation if repeated will extinguish the lamps.

The only part of the apparatus exposed is the lava tip the rest of the mechanism being entirely enclosed in a strong covering which amply protects the parts from injury. The battery box is covered by iron covers which are intended to be opened and cleaned once each year. Complete outfits of this system of gas lighting are furnished by Cutler & Hammer Mfg. Co., 247 South Jefferson St., Chicago.

Shawhan-Thresher Motor and Dynamo.

In the accompany cut is shown an iron clad type of dynamo and motor manufactured by the Shawhan-Thresher Electric Co. of Dayton, Ohio. It is of a style recently placed on the market. Those in use are said to give excellent satisfaction. Its mechanical construction and design are of the first order as shown in the neat lines and well proportioned parts.

The base and frame of the machine is made of cast steel in two parts, so designed as to protect the armature and fields. Sufficient openings are however left for perfect ventilation and to enable all necessary parts to be reached for inspection or repairs. The armature is of the drum type specially wound so that no two windings with a great difference of potential will be near together. The field coils are wound separately and are then slipped over the pole pieces. Repairs are thus easily made. The armature shaft is made of the best material and of sufficient size to maintain a rigid center. The bearings are strong, well made and self-oiling. The brush holders are of a new design and are mounted on well insulated arms which can be shifted by the shifting arm to the required point.



SHAWHAN-THRESHER MOTOR AND DYNAMO.

The company has excellent facilities for the manufacture of these machines of any size desired. The motors are made in sizes from one-half horse power up.

The National Electric Co.

The works and stock formerly owned by the National Electric Manufacturing Co. have been purchased by the National Electric Co., which was recently organized at Eau Claire, Wis. The president of the company is Mr. A. L. Ide; vice-president, Peter Truax; secretary, F. P. Ide, and treasurer, W. A. Rust. The works are well equipped with everything necessary for the manufacture of electrical machinery. The company are prepared to fill orders for alternating and continuous current lighting apparatus, multipolar power generators and motors, transformers of any size or voltage, and a great variety of other electrical apparatus.

Carpenter Enamel Rheostats.

The rheostat forms a necessary part of every electrical installation. Its construction has been brought to an excellent state of perfection by the Carpenter Enamel Rheostat Co. of Bridgeport, Conn. The rheostats recently designed by this company show the ruling ideas in the manufacture of electrical machinery and devices, simplicity and compactness with greater efficiency and increased durability. By comparing the older forms with these of recent construction as great a change is noticed as between the "Jumbo" dynamo and the latest machine of the same capacity.

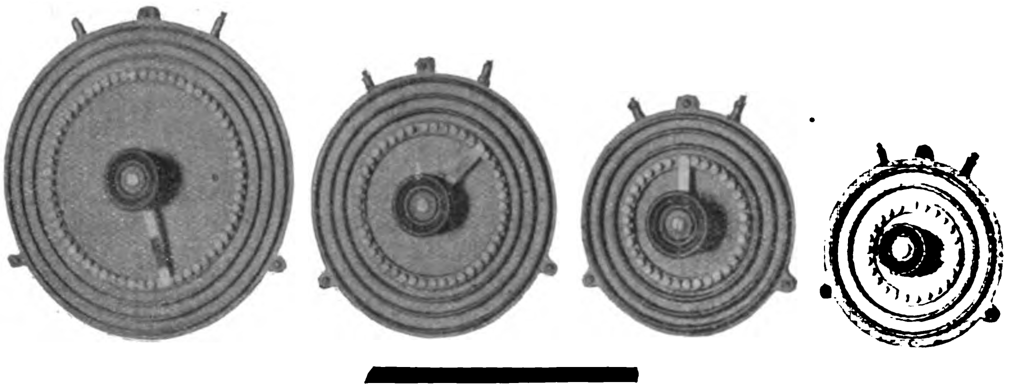


FIG. 1.—CARPENTER ENAMEL RHEOSTATS.

Besides the extensive line of field rheostats and motor starters a great many special forms are manufactured. The fundamental principle upon which the construction of these rheostats is based involves the use of a resistance wire in close proximity to a supporting plate through which the heat is dissipated by radiation. The large open coils of wire are not used, but various forms of plates are used which have large radiating surfaces. In the accompanying cuts are shown several sizes of field rheostats. They are disc shaped with lugs at the side for fastening to the board. Binding posts on the upper edge are at a convenient point for connecting the wire. The contacts are arranged in a circle, and the connection is made through the arm operated by the central knob. Sizes above 60 K. W. are composed of two or more plates with steps connected in multiple as shown in Fig. 2.

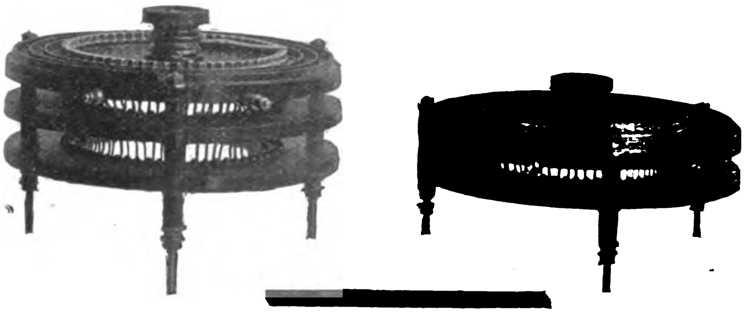


FIG. 2.—CARPENTER EMAMEL RHEOSTATS.

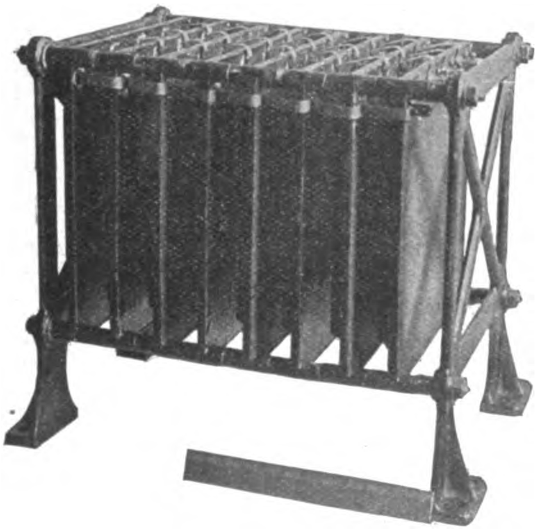


FIG. 3.—CARPENTER ENAMEL RHEOSTATS.

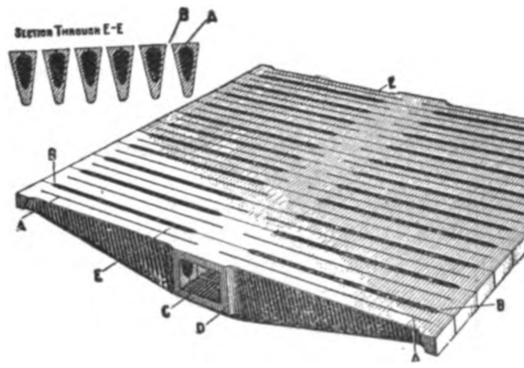
Fig. 3 shows a form of large rheostat composed of eight plates 14 by 14 inches. It is mounted in an iron frame and is just as it is finished without regulating switch. For many places it is desired to place the regulating device at some distance from the rheostat or to connect them to switches of special design in such cases the above is one of of the forms furnished. They are used for traveling cranes, hoists, railway motors, etc.

The Gadey Air Grate.

A new grate devised for securing a more perfect combustion of the fuel, by means of a more thorough circulation of the air, is being placed on the market by Brown Bros. Mfg Co. of Chicago. The form of construction is shown in the accompanying illustration. The grate bars, which are hollow, have a small slot in their upper surface one-eighth inch widerunning almost their entire length. The bars when in position have also an opening between them for the natural draft.

Through the center of each bar there is a large opening so made that when the bars are in position there is an opening through the entire grate, connecting the interior of the bars together. By means of a small blower air is forced into this passageway from which it escapes through the small slots into the fuel to be burned. A generous supply of air is thus forced into immediate contact with the fuel. It is said that screenings will burn on these grates with good results or any kind of fine coal. The circulation of the air through the hollow grate bars prevents them from becoming overheated, thus greatly lengthening the life of the bars. Great economy is claimed for these grates in the more perfect combustion of the coal and the ability to burn a cheap form of fuel in the shape of screenings with nearly as good results as the better grade of coal. The grates are tested before leaving the shops so that a high standard of excellence will be maintained.

Brown Bros. Mfg Co. is the exclusive manufacturer of these grates, and it is the intention to dispose of territorial rights for their sale. This company was founded in 1860 and incorporated in 1874. It is an interesting item of history that during all this time they have been located at the corner of Jackson and Clinton Sts. The foundry has turned out an extensive line of engineering and mechanical devices. A number of these grates have been installed in Chicago and are said to be giving excellent satisfaction.



THE GADEY AIR GRATE.

New Electric Light Push Switch.

A novelty in the push switch line for electric lights is shown in the accompanying cuts. It has recently been introduced to the trade by the Electric Appliance Co. of Chicago, and is known as the Standard single push switch. One of the important features of the switch as seen in the interior view of the switch is that it is operated by a single button. One pressure of the button throws on or off the current.

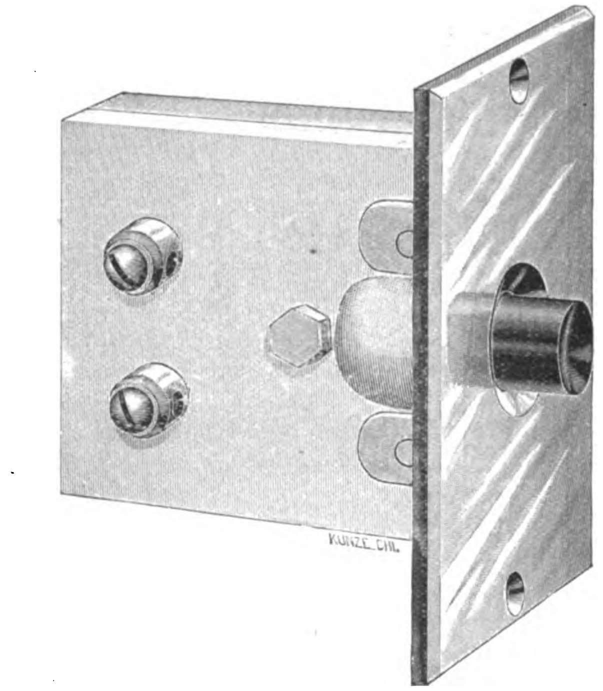


FIG. 2.—NEW ELECTRIC LIGHT PUSH SWITCH.

It is very simple in construction and all parts are substantially made, making a very durable switch. The interior view shows the different parts and the simple method of operating. A quick break is made and there is no danger of a short circuit. Fig. 2 shows the switch actual size. It will take the place of any five or ten ampere snap or flush switch, and is made in the ten ampere single pole and ten ampere three-way styles. A third style will soon be ready for the market, which will be known as the Standard Commutation Switch. In appearance it will be similar to the above, but the contacts are so arranged that a light, or group of lights, can be controlled from any number of points without extra wiring, that is, a light, or group of lights, may be turned on or off from any three or more points independently. These switches are easily put in have a neat and ornamental appearance and do not project into the room. The orders recently received indicates that they are well adapted for the work.

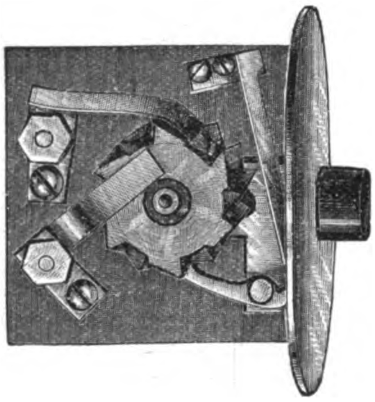
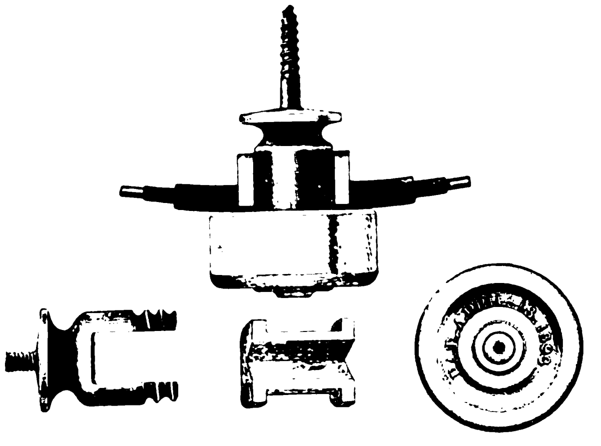


FIG. 1.—NEW ELECTRIC LIGHT PUSH SWITCH.

The Safety Insulator.

In the accompanying cut is shown a new safety insulator recently placed on the market by McLeod, Ward & Co., of 91 Liberty St., New York. Its mechanical construction is entirely new. The cut shows the different parts and the insulator with the wire in place.

The insulating parts are made of porcelain and the frame and screw of iron in one piece. The screw is made in several styles to suit the class of work for which it is required, wood screws for wood work and plaster and machine screws for iron. The frame is easily secured in place and when in place will hold a considerable strain. The upper piece of porcelain is raised slightly at the center of the groove so that when the large porcelain is screwed tight the wire is bent slightly and is held firmly.



THE SAFETY INSULATOR.

The insulator presents a very neat appearance and the absence of tie wire and ends adds much to the appearance of the work done. All parts are substantial and there is nothing which will wear out. It is made in several sizes:

No. 1 for wire from No. 18 to 12, No. 2 for wire from No. 12 to 6 and No. 3 for wire from No. 6 to No. 0 B. & S. guage. A special tap and drill are furnished to be used in connection with the machine screws.

Gifford's Patent Screw Friction Clutch.

The many advantages of friction clutches are well-known to every intelligent power user. Upon the excellence of the design and the mechanical construction of the clutch depend the economy and power of the device. In the accompanying cuts are shown Gifford's screw friction clutch pulley, manufactured by Gifford Bros. of Hudson, N. Y., in which an old and important principle has been put to a new use. The efficiency and economy of a friction clutch depends largely on the perfect contact of the friction surfaces and the stability of the force that holds them together. The power of the screw has long been known for holding two bodies together or of forcing two apart. As used in these clutches not only the power of the screw is used but also the leverage of the arms that turn the screw. This force applying the driving segments to the inner surface of the driver drawn secures a perfect and powerful contact which is easily and quickly made or broken. The screw and lever arm are in one piece, which together with the nuts are made of aluminum bronze. The wooden lags are made of hard well-seasoned maple which are durable and secure in an excellent manner the best results.

The clutch is compact and requires but little space on the shaft. The pulleys and clutches are mounted in a number of ways as the particular work requires. Fig 2. shows pulley mounted on quill which meets the requirements of many electric plants. This firm has furnished the pulleys and shafting for the entire equipment of a number of electric plants which have been looked upon as model installations.

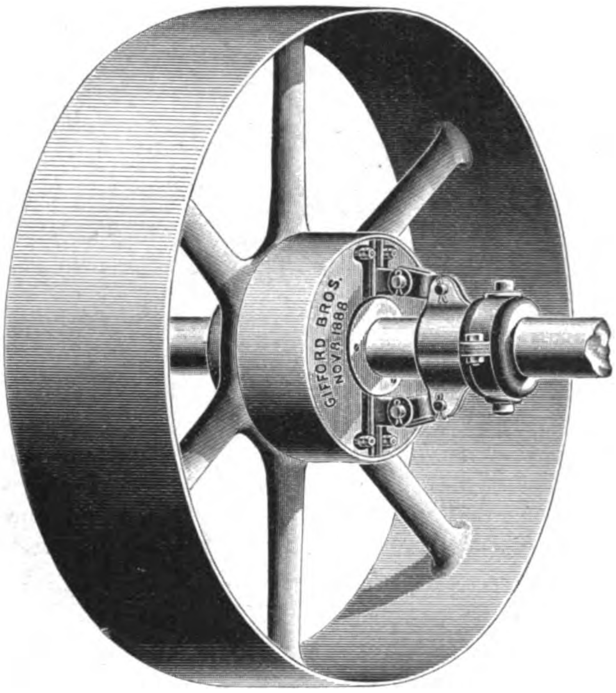


FIG. 1.—GIFFORD'S PATENT SCREW FRICTION CLUTCH.

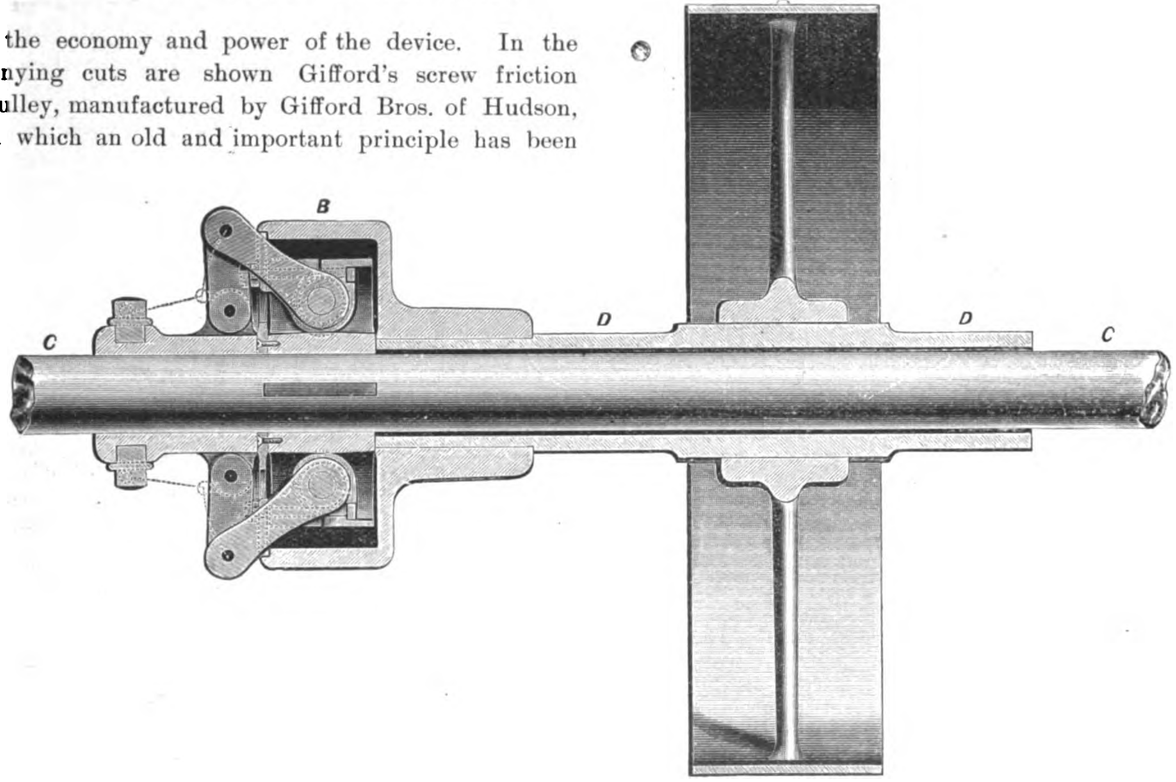


FIG. 2 —GIFFORD'S PATENT SCREW FRICTION CLUTCH.

The Production of Aluminum.

The Consular Reports for December contains a number of communications on the production of aluminum. The process of reduction employed at Schaffhausen, Switzerland, is described in detail in the report of Consul General Richman. The process is an electric one, the invention of M. Herauld. The ore is reduced between two electrodes, the negative of carbon and the positive of copper. The excellent water power of the Rhine is utilized for generating the current of which 1,500 kilowatts are used.

At these works aluminum is produced cheaper than at most other works and for that reason a large industry has been established there. But a difficulty has arisen which so far the manufacturers have been unable to meet. It seems that in the process of manufacture large quantities of fluoric gas is given off. This gas has destroyed the vineyards in the vicinity and rendered it impossible to raise vegetables or fruit. The district affected is extending and unless some means shall be devised of preventing the escape of the gas the companies will be unable to continue the business. The land in the vicinity has been purchased but a number of suits have been instituted for damages from persons at a greater distance from the works.

An Ideal Glass Oil Cup for Dynamo and Engine Bearings.

A newly devised oil cup is shown in the accompanying cut. It is known as the "Crown," and has recently been placed on the market by the Lunkenheimer Co. of Cincinnati, Ohio. The cup is of the sight feed type, and is provided with an index for regulating the flow of oil, and an indicator arm turning on the lid to mark the notch giving the desired feed. The feed may be instantly closed or opened or regulated to any degree required. When the feed is shut off the indicator arm may be left up to indicate that no oil is running.

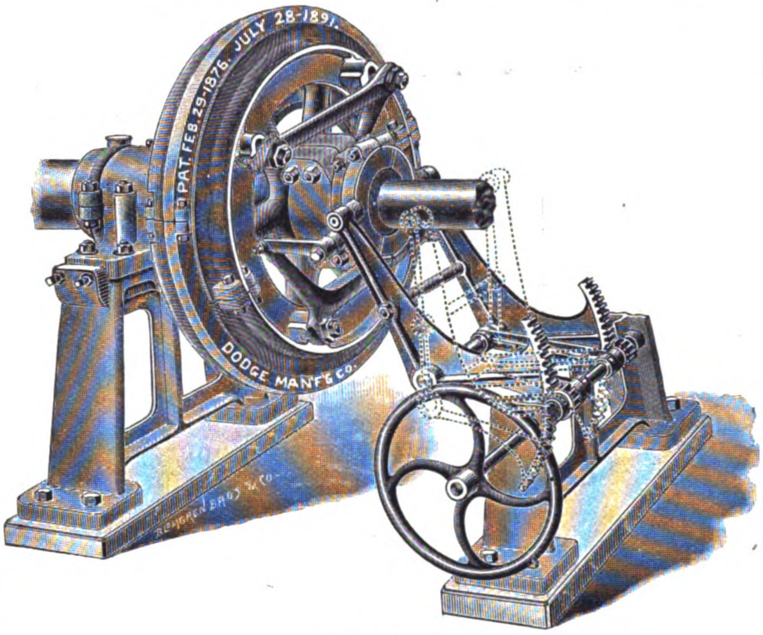
AN IDEAL GLASS OIL CUP FOR DYNAMO AND ENGINE BEARINGS.

Where you have a number of cups from which a large amount of oil is wanted when starting up these cups may be set to feed rapidly, and when in operation the arm may be moved back to the notch which marks the standard feed, thus regulating with little trouble the supply of lubricant. Something of the substantial character of these cups may be gained from the following The cups are all made of cast brass which is handsomely finished, thus making a rigid substantial base. The oil will not leak out between the glass and the brass part as is often the case with a light spun cup.

New Clutch Shifter.

The Dodge Manufacturing Company, of Mishawaka, Ind., has recently placed on the market a new gear for moving friction clutches into and out of gear. It is particularly adapted for use with floor stands, as shown in the illustration, but is also adapted for use with separate foundations and independent standards.

Those who have operated heavy clutches with the ordinary forked lever will readily appreciate the advantages of this power appliance. One of the chief difficulties of the common forked shifting lever is in the tendency of the trunnions to assume positions in the forked slots at different distances from the fulcrum, whereby on the first movement of the fork the trunnions are cramped. This effect is rendered impossible because the two trunnions are held in bearing holes in the end of the bell crank arms, which hemselves are members of a rigid frame. The trunnions are, therefore, always maintained in a proper position.

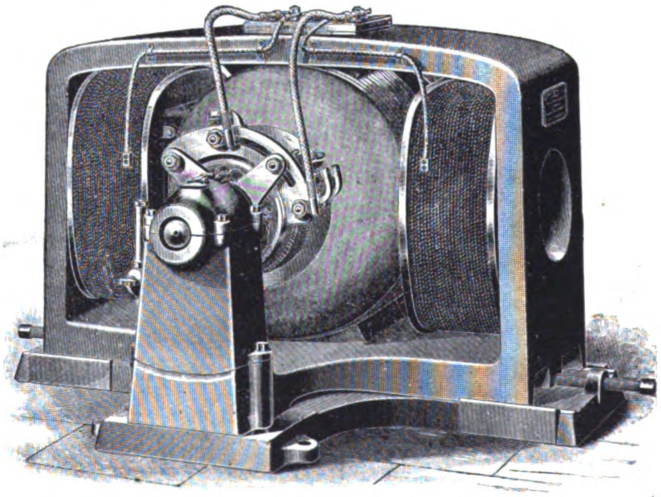

PAT FEB. 29-1876. JULY 28-1891.
DODGE MANF'G CO.

NEW CLUTCH SHIFTER.

The bell crank arms, with the links which tie them to the pinion shaft, constitute a clutch membership whereby the power increases as the resistance increases. At their outer free ends the bell crank arms are provided with gear segments which mesh with pinions on the hand wheel shaft. The clutch, by this arrangement, is easily operated and is quick and firm in its action.

New Motor of the Eddy Electric Mfg. Co.

The motors manufactured by the Eddy Electric Manufacturing Company of Windsor, Conn., have for several years held a prominent place among transformers of electric power. Changes and improvements have been been made in the construction of the motors as experience and new conditions of service demanded, keeping the motors in every respect



NEW MOTOR OF THE EDDY ELECTRIC MFG. CO.

up to the requirements of the times. Recently a new motor has been placed on the market by the company which is a decided departure in mechanical appearance from the well known Eddy types.

This motor which is shown in the accompanying cut is known as type H. It is not intended to supplant the other types but is designed to meet the demand for a slow speed motor. Its simplicity and substantial appearance at once commends it to the power user. A fine grade of soft, cast steel has been selected for the field magnets. The four poles are excited by two coils wound on spools which slip over the steel cores. The mechanical construction and design, as shown in the cut, is such as gives a solid and substantial frame work for the support of the armature. A large magnetized field surface is secured compactly placed about the armature. The carbon brushes are placed radially in neatly designed holders, and its substantial construction makes an efficient machine.

The Climax Rail Cleaner

In the accompanying cuts are shown one of the many railway supplies handled by W. L. Adams & Co., of Chicago. The advantages of a good rail cleaner are well known to every practical railway man. The Climax cleaner is in the form of a V shaped brush seven and one-half inches long and six and one-half inches wide at the rear. This brush is firmly attached to a cast head of the same shape. A saw-blade steel knife is placed at the front of the brush which cuts the sleet and ice from the rail. The remainder of the brush is of strong steel wire which being V shaped throws everything clear of the rail. These rail cleaners are of special advantage on electric roads where a clean rail is necessary to the economical operation of the road. Of substantial construction they are durable, serviceable and will not clog up. For heavy snow there is an attachment that fits over the brush head

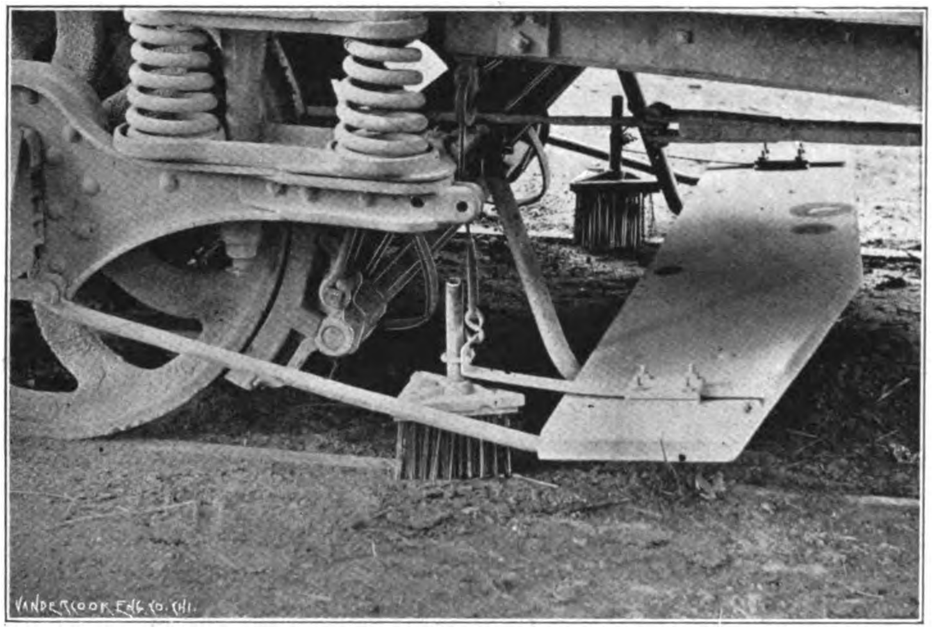


FIG. 1.—THE CLIMAX RAIL CLEANER.

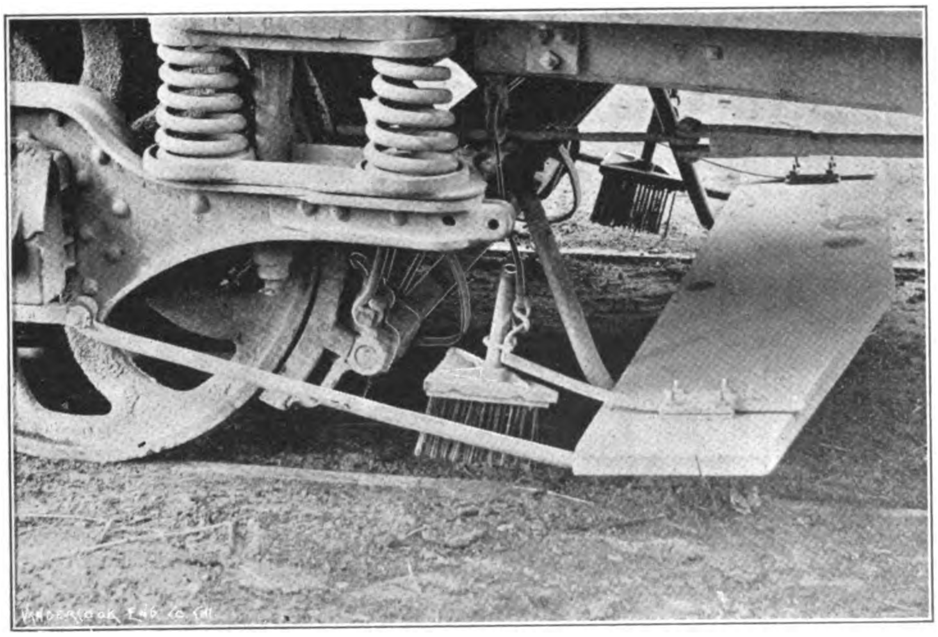


FIG. 2 --THE CLIMAX RAIL CLEANER.

capable of being adjusted to remove all the snow except about half an inch which is removed by the brush.

Fig. 2 shows the brushes raised, when not required and thus saved from wear. A small cable which runs over pulleys and to the staff on the dash-board of the car, supports the brush. The pressure of the brushes on the rail or its distance above the rail may be regulated by a ratchet. They are held in front of the wheels on the rail by a steel spring which holds it with even pressure on the rail. It is however, always under the control of the motor-man. They can be attached to any style of car with equal efficiency.

CORRESPONDENCE.

Letters from Practical Men.

[Owing to the many requests received from our subscribers we have decided to open a correspondence department for practical men through which they may exchange ideas and relate the various experiences and difficulties met with in their work. Communications, therefore, will be gladly received for publication in this department in regard to the operation or construction of lighting, railway and power plants or anything pertaining to the practical applications of electricity. Our readers are cordially invited to make use of this column for both their questions or experiences. The name and address of the writer must always be sent with the manuscript, not necessarily for publication but that the editor may know to whom he is indebted. Eds.]

Neenah, Wis., Dec. 3, 1893.

Editor Electrical Industries: A "Central Station Correspondence Department" would be a very interesting and beneficial feature to your valued journal. I submit the following trouble to some of my colleagues for a solution. We have a 3,000-light compound wound generator that ran for five months without a hitch. At the end of that time it would balk at the end of a ten hours run and could not keep the voltage above 30 on a very light load. I discovered at once that the commutator was grounded on both collector rings, but after cleaning grounds it acted just the same after 10 hours run. A new commutator did not remedy the trouble. The insulation between segments is ample and good. The machine has no ground and others of same size and type run without any trouble at all. Where is the "bug?" "DeL."

Toledo, Ohio, Nov. 28, 1893.

Editor Electrical Industries: I think the addition of a "Correspondents Column" would be a valuable acquistion as it affords many new and valuable ideas.

A. A. Newbert.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Missouri Valley, Ia.—The Missouri Valley Electric Light Company is adding a new dynamo.

Cheboygan, Mich.—W. & A. McArthur (Limited) may add a generator and motors during 1894.

Brooklyn, Mich.—L. W. Greene and Brother, propose to add an arc lighting equipment next fall.

Seymour, Ind.—The Blish Milling Company may install a motor for power, for manufacturing purposes.

Battle Creek, Mich.—The Citizens Electric Company contemplate adding a power circuit and generator.

Charleston, Mass.—The Charleston Gas & Electric Company contemplates a large increase of its equipment.

Elkhart, Ind.—The Elkhart Electric & Railway Company's plant is to be sold by the receiver, Jan. 18, next.

Indianapolis, Ind.—The Home Brewing Company may add another dynamo. A. Hagen is purchasing agent.

Peterboro, N. H.—The Peterboro Electric Light, Power & Heat Company contemplate the transmission of power three and one half miles for manufacturing purposes. A. W. Ives is purchasing agent.

Leon, Ia.—The city plant will use arc lamps on its incandescent current. F. E. Thompson is purchasing agent.

Warrensburg, N. Y.—The Warrensburg Electric Light Works will be put into operation about Jan. 1st, '94.

Topeka, Kan.—The Edison Electric Illuminating Company are installing an alternating dynamo and an engine.

Petaluma, Cal.—The Petaluma Electric Light & Power Company contemplate the addition of twenty arc lamps.

Frederick, Md.—The Frederick Electric Light Power & Company contemplates doubling its present capacity.

Marshalltown, Ia.—The Iowa Soldiers Home will increase the capacity of its lighting plant by adding a dynamo.

Anna, Ill.—The Illinois Southern Hospital for the Insane will increase its lighting capacity by adding arc lights.

Sullivan, Ill.—The Sullivan Electric Company, John H. Baker, owner, proposes to add an incandescent dynamo.

Columbus, Kas.—The Columbus Electric Company contemplates adding a dynamo, engine and boiler to its equipment.

Berkley, Va.—The Berkley & So. Norfolk Light and Water Supply Company may install its plant in spring of '94.

Rockville, Ind.—The Rockville Electric Light & Power Company will extend its lines. O. O. Wright is purchasing agent.

Atlantic, Ia.—An engine and additional dynamos are to be installed in the city plant. A. M. Nipper is purchasing agent.

Ashland, Ky.—The Ashland Electric Light & Power Company will install a power generator. F. B. Moore is purchasing agent.

Tuscumbia, Ala.—The Tuscumbia Water Company contemplates increasing its lamp capacity. C. A. Womble is purchasing agent.

Humboldt, Tenn.—A plant will probably be installed in the spring. Jno. T. Crews, Secretary of Commercial Club can give particulars.

Leavenworth, Kan.—The Leavenworth Light & Heating Company will furnish power for the street railway upon its completion.

Notre Dame, Ind.—The University of Notre Dame contemplates an addition to its incandescent plant. M. O'Dea is purchasing agent.

Marion, Ill.—The Marion Electric Light & Street Railway Company proposes to extend its lines. W. H. Warder is purchasing agent.

Clarinda, Ia.—The Clarinda Electric Light and Power Company contemplates an extension of its lines. A. G. Van Sandt is purchasing agent.

Catlettsburg, Ky.—The Carpenter Electric Light & Power Company will add more arc lights for city use. D. H. Carpenter is purchasing agent.

Winchester, Ky.—The Winchester Electric Light & Power Company contemplates the installation of an arc system. V. W. Bush is purchasing agent.

Chanute, Kan.—The Chanute Electric Light & Power Company may add an alternating incandescent system. G. W. Alcock is purchasing agent.

Ligonier, Ind.—The Ligonier Electric Light Company will add an engine and an incandescent system in the spring. J. W. Draper is purchasing agent.

Chariton, Ia.—An incandescent dynamo is to be added to the equipment of the plant owned by the city. Frank Granger is purchasing agent.

Lexington, Ky.—The Central Electric Company will add a large engine and incandescent dynamos by March next. E. J. Richards is purchasing agent.

Oakland, Cal.—The Oakland Electric Light & Motor Company will add to its equipment more dynamos and an engine. R. P. Valentine is purchasing agent.

Kankakee, Ill.—The Illinois Eastern Hospital for Insane contemplate renewal of main feeders and requiring 600 lights. Dr. Clark Gapen is purchasing agent.

Rochester, Ind.—The Rochester Electric Light Company contemplate the installation of an incandescent system in the spring. O. D. Ross is purchasing agent.

Winchester, Ind.—The Winchester Electric Light Company will extend its incandescent service and increase its power plant. O. L. Moonnan is purchasing agent.

Boston, Mass.—The Edison Electric Illumininating Company contemplates extending its underground wire system and installing a storage battery for 3,200 amperes.

Tipton, Ia.—The Tipton Electric Light Company, which recently commenced operations, contemplates the installation of an arc system. W. N. Freichler is manager.

Logansport, Ind.—The Northern Indiana Hospital for the Insane will add to its lighting equipment when new buildings are put up. Dr. J. C. Rogers is purchasing agent.

Davenport, Ia.—The Davenport Power & Light Company contemplate adding an engine, dynamo and a power generator to its equipment. Wm. Mullen is purchasing agent.

Fort Leavenworth, Kas.—The lighting system of the United States Military Prison is to be extended in order to light an adjacent hall. Capt. J. W. Pope is purchasing agent.

Sycamore, Ill.—The Sycamore Electric Light Company will add to its equipment a new boiler, engine, and incandescent dynamo next May. John B. Whalen is purchasing agent.

Baltimore, Md.—The Brush Electric Company is rebuilding its plant which was recently destroyed by fire. The capacity of the new plant will be about fifty per cent more than the old one.

FINANCIAL.

The close of the month witnessed the usual quiet attending the holiday season. No great activity is noticed in any department. The improvements contemplated for the coming year would indicate larger sales of apparatus and supplies, but not as promising as one year ago. The great difference in the business of the years 1892 and 3, is no where shown so clearly as in the reports of the volume of business transacted, in the number of failures and in the total liabilities of those business houses which for 1893 exceeds by 400 per cent those of 1892. The new companies contemplating business for the coming year are not numerous.

The stock market has not been active. Especially is this true of electrical stocks and securities. The first of the month was a disappointment to many holders of electric stocks. Despite the many reports tothe contrary, the directors of the General Electric Company passed the dividend on the preferred stock. The announcement at once caused a decline in the price of the stock. The policy of the officials of the company is commended by some and later reports say that the report of the company which will be made February 1st for the year 1894 will show the company in a good financial condition. It is also again reported that several changes will be made in the management of the company.

The stockholders of the West End road were also disappointed in the size of the dividend, which was at the rate of 6 per cent. instead of the 8 per cent. formerly declared. The Western Union declared a regular quarterly dividend of 1¼ per cent. payable January 15th. The Bell Telephone Co. declared a regular quarterly dividend of $3 per share and an extra dividend of $3 payable January 15th.

The directors of the Westinghouse Electric & Mfg. Co. declared a semi-annual dividend of 3½ per cent. on the preferred stock, payable January 10th.

Name of Company.	Description of Security.	Amount Issued.	Par Value.	Rate Int.	Date Payable.	Closing Dec. 29
Miscellaneous Securities.						
American Bell Telephone Co	Stock.	$17,500,000	100		J. Q.	184
“ “ “	Bds. 1893.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co	Com.	14,000,000	100			85
Commercial Cable Co	Com.	7,716,000	100			120
Edison Elec. Ill. Co., Boston	Com.	2,025,800	100		F. Q.	124
“ “ “	C.Bds. 1898.	71,000	100	6	M. & S.	
“ “ “	C.Bds. 1901.	586,500	100	6	M. & N.	
“ “ Brooklyn	Com.	2,500,000	100		Q. F.	85
“ “ “	1st. 1940.	500,000	100	5	A. & O.	
“ “ “	Regis.		100	5	A. & O.	
“ “ Chicago	Com.	3,000,000		8	Q. F.	
“ “ “		2,500,000				
“ “ New York.	Com.	7,938,000	100		Q. F.	97
“ “ “	1st 1910.	2,562,000	100	5	M. & S.	103
“ “ Phila	Com.	1,473,000	100			120½
“ “ “				5		
Fort Wayne Elec. Co	Com.	4,000,000	25			4½
General Electric Company	Com.	30,457,000	100			33¼
“ “	Prf'd.	4,251,900	100			65
“ “	Deb. 1922.	10,000,000	100	5	J.-D.	71
Gold & Stock Tel. Co	Com.	5,000,000	100		Q. J.	
Northwestern Gen. Elec. Co	Com.	1,000,000	100			
“ “	Prf'd.	750,000	100		J. Q.	
Thomson Elec. Welding Co	Com.	1,000,000	100			
Thomson European Welding Co.	Com.	1,500,000	100			
Thomson-Houston Elec. Co	Series D.	120,000	10			5⅜
Thom'n-Houst'n Intern. Elec. Co.	Com.	600,000	100			
“ “ “ “	Prf'd.	400,000	100			
United Electric Securities Co	Com.	1,000,000	100			
“ “ “	Prf'd.	1,000,000	100		F. & A.	
Western Union Tel. Co	Com.	94,820,000	100		Q. J.	81¼
“ “	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50			26
“ “ “	1st Pf.Cum.	3,755,700	50	7		46
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R	Com.	6,000,000	10		Q.-J.	170
“ “	1st Bds.1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R	Com.	500,000	100		Oct. 1.	
“ “ “	1st Bds.1909	300,000	100	5	J. & J.	
“ “ “	Certf. 1894.	300,000	100	6	J. & J.	
BUFFALO—						
Buffalo St. Railway	Com.	5,370,500	100	5		
“ “	Bds. 1931.	5,000,000	100		F. & A.	
BOSTON—						
West End St. Railway	Com.	9,085,000	50		J. & J.	58
“ “	Prf'd.	6,400,000	50	5	J. & J.	80
“ “	Bds. 1902.	3,000,000	100		M. & N.	
LOUISVILLE—						
Louisville St. Railway Co	Com.	5,000,000	100			
“ “	Prf'd.	1,000,000	100	5	A. & O.	
“ “	1st Bds.1930	6,000,000	100		J. & J.	
NEWARK, N. J.—						
Newark Passenger Railway	Com.	6,000,000	100			27⅜
“ “	Bds. 1930.	6,000,000	100	5	J. & J.	84½
NEW YORK—						
Union Railway Co	Com.	2,000,000	100			155
“ “	Bds.	2,000,000	100			
PITTSBURGH—						
Duquesne Traction Co	Com.	3,000,000	50			22
“ “	Bds. 1930.	1,500,000	100	5	J. & J.	98
Fed. St. & Pleas. Val. R. R	Com.	1,400,000	50		J. & J.	17
“ “ “ “ “	Bds. 1919.	1,250,000	100	5	J. & J.	100
Pittsb'gh, Aleg. & Man. R. R	Com.	3,000,000	50			38
“ “ “	Bds. 1931.	1,500,000	100	5	J. & J.	100
Pittsburgh & Birming. R. R	Com.	3,000,000	25			14½
“ “ “	Bds. 1929.	1,500,000	100	5	M. & N.	98
ROCHESTER—						
Rochester Railway Company	Com.	5,000,000	100			67
“ “ “	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway	Com.	2,500,000	100		Q.-J.	60
“ “	Bds. 1910.	1,500,000	100	5	J. & J.	97
St. Louis & Suburban	Com.	2,500,000	400			50
Union Depot Railway	Com.	1,200,000	100			
“ “ “	Bds. 1910.	1,000,000	100	6	A. & O.	100

NEW BOOKS.

The Electric Transformation of Power and its application by the Electric Motor, including Electric Railway Construction, by Phillip Atkinson, 1893, New York. D. Van Nostrand Company, 23 Murray St. London; Crosby, Lockwood & Son, 7 Stationer's Hall Court, Ludgate Hill. 240 pages 12 mo. 96 ills., cloth, price postpaid, $2.00.

The excellent idea of the author of presenting "in plain, untechnical language the essential facts in regard to the means by which electricity is employed as an agent for the transformation and transmission of power, and its application to the operation of machinery," has been fully carried out. The work is fully up to date and the important position which the electric motor occupies at the present time as a means of power is set forth in a clear and comprehensive manner. All historical matter is absent and the pages are devoted entirely to the subject. In the few pages which comprise the first chapter a few electrical terms and units are described to enable the readers unacquainted with the subject to understand to better advantage the succeeding pages. Chapter II enters upon the subject with a very complete description of the electric motor describing very minutely the different parts of the motor and showing the work done by each part. The construction of motors and a comparison of the different types is also included in this chapter. The prominent stationary motors manufactured in the United States are illustrated in Chapter III, both continuous current and alternating. The special characteristics of each motor are dwelt upon. In the next chapter the applications of the stationary motor is discussed in a practical manner. The adaptation of the motor for the different kinds of work; the method of applying it, of controlling and the results from an economical and a mechanical points are discussed. Numerous cuts show the machines. Electric railways and railway motors are next taken up. The construction of the electric railway is described in detail, the different overhead material used and the different methods of providing for the return circuit accompanied by numerous cuts illustrating the appliances used. In treating of the railway motor the later types of motors are described and discussed. The different systems of elevated, conduit and under ground railways in practical operation are described. The work concludes with the central station and power house. The subjects are treated from a practical standpoint entirely, theory is excluded and the future is left to another.

TRADE PUBLICATIONS.

The Link Belt Machinery Company, Chicago, has recently published a very neat folder, printed in brown ink on fine paper descriptive of the Standard water tube safety boiler and the Ewart clutch, two of its leading specialties.

Goodhue & Lincoln are preparing a book treating exclusively on the subject of transformers, alternating arc lamps and alternating motors, single phase, exclusively for use of alternating stations. The book will go into the subjecct elaborately.

Many amusing things are found in the little pamphlet issued by the Goodrich Hard Rubber Co., of Akron, Ohio. The hard rubber electrical supplies manufactured by the company, are presented in a way devised by Mr. Clark, whose ability as a humorous artist is well shown on the pages.

A handsome and well made catalogue of the Triumph dynamos and motors has just been issued by the Triumph Electric Company of Cincinnati, O. The cover is pretty, the paper of an excellent quality, and the press work of the first order. The features of the dynamos and motors are presented in a comprehensive manner.

The Clayton Air Compressor Works, of New York, has recently issued in pamphlet form the article on "The Widening Use of Compressed Air," by Whitfield Price Pressinger. The article appeared in the November number of the Engineering Magazine. It briefly reviews the many applications of compressed air, and refers to a number of large works in which compressed air is used.

Bicycle power plating dynamo is described and its many applications illustrated in a pamphlet recently issued by the Hanson & Van Winkle Co. of 81 Liberty st., New York. The appliances necessary to accompany the dynamo to complete a platers outfit are also illustrated and prices listed. A special catalogue for amateurs showing plating outfits of smaller size than the regular catalogue is among the new catalogues.

The last number of Popular Astronomy, published at Northfield, Minn., has for a frontispiece a view of the Yerkes telescope as it stood in the Manufactures and Liberal Arts building at the Fair. The number also contains several articles on comets by well informed authors and several serials, also short articles on timely subjects. This monthly seems to have supplied a field which few have been able to fill satisfactorily.

Huebel & Manger's new catalogue of electrical and brass goods has just appeared. A perusal of the catalogue shows the many improvements this firm has made recently in its line of goods. The line of electric bells listed includes almost everything manufactured. The improvements recently made in the binding posts and contacts are illustrated in detail. The push buttons and combination push button plates embrace an extensive variety.

A very attractive catalogue has just been issued by the Washington Electric Company of Chicago. It is nicely gotten up and shows to good advantage the different manufactures of the company. The new Washington arc lamp for alternating current circuits is illustrated in detail. An extensive line of apparatus for theater lighting, including focusing lights of various sizes and for various special uses, dimmers, and numerous attachments are shown. Annunciators for almost every place and use and in numerous sizes are listed.

The multipolar dynamos and motors manufactured by the Elliott-Lincoln Electric Company of Cleveland, O., are presented in an excellent manner to contemplative buyers in the catalogue recently issued for 1893-4. The many features of the machines are clearly shown by means of cuts accompanied by complete descriptions. The different parts of the machines are shown separately, and by diagrams the method of connect [illegible] d ferent styles of motors are shown. The pages at the back of the catalogue are full of valuable tables and formulæ.

The electrical business houses are noted for the excellence of their catalogues, which surpass in size and general make up those of almost any other line of trade. The constant change in the designs and character of the goods requires the catalogues to be issued at frequent intervals involving a large expense. The Electric Appliance Co. of Chicago has just issued catalogue No. 6, the latest edition of its complete catalogue of electrical supplies. The book is handsomely gotten up, compact and as concise as possible, all superfluous matter being omitted. Yet nothing is omitted that could possibly add to the value of the catalogue. Heavy purple "princess" covers with lettering in fire bronze give the book a neat appearance. The arrangement of the catalogue is commendable. The first division of the book is devoted to incandescent light supplies, which includes everything necessary for the installation and operation of an incandescent lighting system, cuts of the Packard lamps, cutouts, brackets, electroliers and all accessories accompany the descriptive matter. Arc lighting and station supplies are next listed, which include the necessary apparatus and supplies for central stations, including the line supplies, lamps, carbons, globes, spark arresters, etc. The next division is devoted to tools necessary in electrical work, for maintainance or construction. A variety of these goods are listed which enable the purchaser to suit his taste in his selection. This list undoubtedly covers everything used in electrical work. Under the head of construction material are found the goods for every kind of electrical installation. The list of wires is quite extensive, and include the "Paranite," the "O.K.," weatherproof variety of annunciator, bare copper, galvanized iron, fixture wire, resistance wire, etc. Numerous cuts show the different kinds of interior conduit and the accompanying fittings, junction boxes, etc. Under the head of testing instruments ammeters, voltmeters, batteries, bridges, and portable testing sets are listed. A full line of motors make up that department. The list of house goods requires a hundred pages of closely arranged matter and closes the book. An elaborate cable code has been arranged enabling customers to order goods by telegraph at small expense although a variety of goods is desired. The code words accompanies every article, and also a catalogue number. The volume is well indexed so that articles are easily found and quickly referred to. The catalogue is of large size and yet not bulky. The pages are six by nine inches and number about 350. It show the charateristic enterprise of the Electric Appliance Company in placing before the trade, even after a season of business depression, a catalogue which is fully up to the times and representative of the advancement in electrical construction.

PERSONAL.

Mr. Samuel Insull, president of the Chicago Edison Co., has just sailed for Europe on a short trip.

Mr. F. R. Chinnock, for the past two years eastern sales agent of the Ball Engine Co., has resigned his position and will enter the electrical field.

Mr. Walter C. McKinlock, secretary of the Metropolitan Electric Co., has just returned from an extended business trip, and reports the outlook as promising.

Mr. Horatio A. Foster, of New York, first assistant of Prof. George Forbes the well known electrical engineer, was married at Chicago on Friday, Dec. 22nd, to Miss Florence Louise Root daughter of Mr. and Mrs. Richard Root, of Chicago. Electrical Industries extends its hearty congratulations.

Mr. Jas. I. Ayer, who has been prominently connected with electrical interests for several years, and as general manager of the Municipal Electric Lighting & Power Company has taken an active interest in the electrical industries of St. Louis, has associated with himself Mr. H. P. Boughton and opened an office of consulting electrical and mechanical engineers in that city with offices in the Security Building.

BUSINESS NOTES.

The Bryant Electric Co., of Bridgeport, Conn., recently placed on the market a new arc cut-out which has a number of points of merrit.

The Peterson Electric Works, of Milwaukee, has had on exhibition at the works a model of a new electric railway system, the invention of Mr. Peterson.

The American Electrical Works are now established in its new quarters at East Providence, R. I. The works contain everything necessary for the manufacture of the company's well-known goods.

The Card Equipment Company has recently been organized at Mansfield, Ohio, with a large capital for the manufacture of a street railway motor and equipment which has been designed by Mr. Geo. F. Card.

Mr. George Cutter, 851 The Rookery, Chicago, reports an excellent trade in street hoods and hangers both in the east and the west. A number of large sales have recently been made of the "Cutter Hoods."

Cushing & Morse, 225 Dearborn St., Chicago, remembered their many friends and customers by a very neat little box containing a "before" and "after" accompanyment of the Christmas dinner. The box bore in gold letters the words: "Have one on Cushing & Morse." "Kerite."

The Elson & Brewster Engineering Co., the New York representative of the W. S. Hill Electric Company, has removed from No. 122 Liberty street, to the Central building at 141 Liberty street, where larger and more convenient quarters give it greater facilities for handling its extensive trade.

The Consolidated Engineering Company, St. Louis, Mo., has installed several electric plants this year in Illinois and Missouri. This company takes contracts for putting in entire plants, including engines, boilers, dynamos and the complete electrical equipment.

The Western Electrical Supply Company, St. Louis, Mo., report a much increased trade for December. Mr. Scudder, the manager of the company, has recently returned from a trip through the southwest and says business in that section does not seem to have suffered from the general depression.

L. K. Comstock, 1437 Monadnock Block, Chicago, has recently received the contract for the electrical equipment of the new Champlain building at the corner of Madison and State streets. This building, which is an office building, will have 3,600 lights. The current will be supplied by the Chicago Edison Co.

The Great Western Manufacturing Co. of Chicago is extending its business by establishing agencies in many of the large cities of the country. The company is now installing central plants and the entire electrical equipment, including dynamos, lamps, transformers, etc., which are manufactured by the company.

Messrs. Wm. Hood and C. E. Osburn, of 239 La Salle St., Chicago, have taken the western agency for the LaRoche Electric works' motors and dynamos. These gentlemen are both well known to the electrical fraternity in the west and they will thus be able to push the sales of this company's product to great advantage.

Messrs. J. W. Parker & Co., 41 North 7th street, Philadelphia, Pa., who have for years represented the Ball Engine Co., of Erie, Pa., in Philadelphia, will also act as its representative in New York after January 1.

Taylor, Dee & Mack, formerly Taylor, Goodhue & Ames, 348 Dearborn street, Chicago, report a steadily increasing business. While young as a firm, these gentlemen can properly claim to be pioneers in the electrical supply business, and offer purchasers all the advantages pertaining to an experience of over eight years in this particular line.

The National Water Tube Boiler Company, of New Brunswick, N. J., recently sold the large exhibition plant at the World's Fair, which aggregated 1,500-horse power of boilers. The Ohio Steel Company, of Youngstown, Ohio, was the purchaser. The plant will be taken down and set up at the steel company's works as soon as the work can be accomplished.

The National Electric Company, Eau Claire, Wis., announces that it is ready to supply any and all orders for alternating and direct current dynamos, generators, motors and apparatus of any capacity and voltage. The works which were for a while closed are again open and are fully equipped for the manufacture of all kinds of electrical machinery.

Wiley & Phelps have opened an office at 1422 Monadnock Block, Chicago, and will make a specialty of handling DeLaval steam turbines and electrical goods. The firm is composed of Mr. W. J. Phelps, who was formerly connected with the office of the Brush Electric Co., in this city, and Mr. G. P. Wiley, who has already made many friends among the electrical trade.

The Ball Engine Co., Erie, Pa., has sold the 500-horse power cross compound condensing engine which was exhibited at the Fair to the Maryland Lighting Company, of Baltimore, Md. This engine drove the dynamos that furnished the light for the electric fountains. It was a neatly built and serviceable engine, and for its excellent operation at the Fair received the "highest award."

The Clayton Air Compressor Works, 43 Dey St., New York, furnishes gratifying reports of the steady operation of the works at their full capacity. The company recently took out several patents on a new tripple compound high pressure air or gas compressor used in the manufacture of carbonic acid gas. In spite of the prevailing depression of business the company has done a good and successful business.

Geo. G. Carter & Company is the name of a new firm of selling agents having offices in the Monadnock Building, Chicago. Mr. Geo. G. Carter, formerly with the Ansonia Electric Co., and Mr. Geo. L. Thayer, for several years connected with the Westinghouse Electric & M'f'g Co., comprise the new firm, which represents the American Carbon Co., the Helios Alternating Arc Lamp, the Pumpelly-Sorley Storage Battery Co., and the Archer Incandescent Lamp.

The Missouri Electric Repair Company, St. Louis, Mo., are making a specialty of coils for T-H and T-H-G. E. arc armatures with the new style Gramme ring, and are carrying an assortment of these coils constantly in stock. This company has also repaired over 300 converters of different sizes and various makes during the past three months. Mr. E. B. Tyler, the manager of the company, was for a number of years with the Brush people and is known personally to hundreds of electrical people.

The Knapp Electrical Works, Chicago, have removed to their new store, 271 and 273 Franklin St. In a few days it is hoped to have everything well settled. As mentioned in these columns last month, the new offices and storerooms have been fitted up in an elegant nanner and they certainly compare favorably with any in the city. Mr. M. A. Knapp, the proprietor, is well pleased with the new location and says that the new quarters make the largest electrical supply store in the United States.

The Central Electric Co., 116-118 Franklin street, Chicago, is carrying a full line of McCreary's specialties at its Chicago warehouse. The company, ever ready to meet the demands of the trade, carry a large stock in order to ship promptly all orders. A number of orders have just been received for Cutter's push switch, both single and double pole. A number of construction orders have just been received, one of them being for the conduit, fittings and Okonite wire for one of the finest residences in Ohio.

Queen & Co., Philadelphia, Pa., say that the success of the Acme portable testing sets has lead them to bring out a style B, which is a completely self contained set, having bridge, rheostat, D'Arsonval galvanometer, battery and keys in one box. The box is but 8¼ by 5¾ by 5 inches, finished in polished mahogany and complete weighs less than six pounds. The compactness of the outfit is a special point in its favor as it is on that account a most convenient form for an electrical engineer to carry about. A circular numbered 445 is sent out to those who may desire it describing it in detail.

Goodhue & Lincoln, 1564 Monadnock Block, Chicago, Ill. although but lately organized as a firm, have proved themselves remarkably vigorous in making their influence felt throughout the country. They report that, notwithstanding general depression of business, they have secured a good many satisfactory orders. Among others they have recently secured contracts for 2,500 lights in transformers, as well as other of their specialties. This firm report that they intend to handle only the highest grade electrical material.

The Western Electric Company, Chicago, is pushing its work of installation at the California Midwinter International Exposition as fast as possible under the direction of Mr. Goldschmidt and his five assistants. The apparatus is all on the ground and it is expected that everything will be completed in time for the opening, which is expected to occur soon after Jan. 1st. In addition to the apparatus and novel features that this company will put in as its exhibit it is also wiring a number of the other Exposition buildings for lighting.

The Adams Electric Company, Worcester, Mass., is one of the recently organized electric companies in the east. Mr. A. D. Adams was formerly electrician and manager of the Commercial Electric Co., but resigned on December 1 and in company with others organized the Adams Electric Co. Dynamos and motors will be manufactured in sizes from 1 to 25 K. W. The field magnet cores will be of forged iron and in the insulation of the armature coils fireproof insulation will be used. A number of other improvements have also been made in the designs of the new machines. A new shop is being put in shape at 100 Beacon street, and the company expect to be able to fill orders this month.

The Link Belt Machinery Company, Chicago, will hereafter manufacture in the west the Standard water tube safety boilers under the Caldwell patents. The Standard boiler has many distinctive points of excellence and the fact that this well known company has taken hold of its manufacture insures its success in a territory in which its sales have not heretofore been pushed. The company has had many year's experience in the equipment of power plants with shafting, pulleys, rope transmissions, etc. Mr. S. K. Gregg who has had a very extensive experience selling similar boilers will act as a general sales agent for the Standard, and will also have associated with him Mr. J. H. Gregg.

The Columbian Incandescent Lamp Company, St. Louis, Mo., has secured a lease of the property adjoining the present factory at 1912 and 1914 Olive St., and has already begun alterations which will increase the output of the factory to 15,000 lamps a day. Mr. J. H. Rhotehamel has recently returned from a trip to New York, where he secured some important evidence that will be presented at the final hearing of the suit brought by the General Electric Company against his company. Mr. Rhotehamel is confident the court will decide that Mr. Goebel was the original inventor of the incandescent lamp. The Columbia factory is probably the best arranged incandescent lamp factory in the world; there is no "lost time" in the handling of a lamp during the process of manufacture.

The Electric Appliance Co., Chicago, has secured the western agency for the new Washington arc lamp. The lamp is simple in construction, having few parts, and a neat appearing lamp. The company has worked up a considerable trade in switches and the new push switch seems to meet the requirements of many installations of the higher order. The O. K. weatherproof wire handled by the company has been on the market for years so that its quality has been thoroughly tested. The regular customers for this wire include those in every department in which insulated wire is used. Quotations are furnished customers at every change in the price of the wire due to the fluctuations in the cost of the raw material so that customers are immediately aware of any reduction in prices.

The Chas. E. Gregory Co., 47 S. Jefferson St., Chicago, report business for December 50 per cent better than the same month in 1892, and are encouraged to carry a much larger stock for 1894. A total sale of 219 dynamos and motors are reported for the year just closed, and Mr. Gregory reports that these sales could have been doubled were it not so difficult to obtain good selling apparatus. Arizona, New Jersey, Montana and Florida are on record as having purchased dynamos from the house and without the aid of a traveling representative. Since the close of the Fair Chicago seems to be looked upon as the bargain counter of the United States, and to this fact is probably due the increased business reported. The purchase of 490 arc lamps, 61 dynamos and motors and 120 assorted ampere and voltmeters during December has so increased the stock that Mr. Gregory feels confident of filling almost any order received.

The Metropolitan Electric Co., Chicago, has added another very important item to its list of specialties in a new incandescent lamp called the Metropolitan. The lamp is manufactured by new and improved methods. It is of high efficiency and it is said, will maintain its candle power throughout its life. The lamp is patented and the Metropolitan company will guarantee that it is non-infringing in every respect. A large stock is kept constantly ready for shipment so that immediate deliveries can be made. The list of railway supplies is being added to constantly and repairs of all kinds are kept on hand. The N. I. R. feeder wire is extensively used and in order to ship promptly a large stock of from 0000 to 16 is kept on hand. Complete switchboards are furnished by the company in accordance with plans furnished by the customer or from the design of the engineer of the company. The Mac tape, a new insulation for joints and places likely to be injured, is especially good for armature and field wrapping. It is put up in half pound packages, three-quarters of an inch wide.

ELECTRICAL INDUSTRIES.

Vol. V. CHICAGO. February, 1894. NEW YORK. No. 2.

The National Electric Light Association.

For its seventeenth convention the National Electric Light Association assembles on Feb. 27th at Washington D. C. The indications are that the attendance will be fully up to that of past conventions. The officers of the association have arranged an excellent and attractive program; specially low rates have been secured from the passenger associations for transportation; a large and well appointed hostelry has been selected for the headquarters of the members, which together with the many attractions of the city itself should draw together a large representation of the electrical interests of the country. An extra effort has been made to interest a larger number of the central stations in this convention.

Less than thirty states are now represented on the roll of members. The western and southern states should be as much interested in the work and benefits of the association as the eastern states. The work accomplished by the National Electric Light Association has been far reaching in its efforts. To enlighten the public in regard to this new force then being introduced was one of the first things undertaken. The information distributed through its members, its reports and papers published by the technical press acquainted the public with the character and benefits of this new light. Its action in securing just legislation will be to the continual benefit of the industry while the advantages of the organization to the individual members in the opportunity for the interchange of ideas, of securing information necessary to the successful operation of a station, of seeing the latest apparatus and devices placed on the market, of securing the successful accomplishment of an issue impossible to an individual but comparitively facile to an association of this size.

The members will bring forth at this convention the new ideas, new discoveries and the new practices which the year 1893 has produced. No year has been more fruitful in ideas and new experiences than the year just past. The Columbian year has been a remarkable year for the commercial producers of electricity. The great exposition brought into comparison the practice of the world. The best that the manufacturers of this country could produce was there; the different methods of generating, distributing and utilizing electricity were there shown complete in every detail and the station manager who saw these exhibits went home with a better knowledge of the electrical developments, looked over his plant and as far as possible made use of this knowledge. Sufficient time has elapsed for the alterations to be tested and at the coming convention we will undoubtedly hear something of the results.

The year has been especially known for the general depression of business. The central station has felt this as much as any one. It has been the tendency in every trade to economize and one of the first things cut down is the light bill and only what is absolutely necessary used. The boilers, engines, generators, feeders and mains of the station have a certain capacity at which the plant can be most economically operated which is usually near the maximum and which yields the best returns to the stockholders of the company. As the customers cut off the lights the number of lights not only decreases but the cost of producing each light is increased. The economical operation of a station has thus been brought more forcibly before the manager of the station, competition and the introduction of new machines and devices are constantly affecting the prices.

Under the popular impression that a city or town can build a station, generate its own current and operate the system at lower cost than a private company, a large number of municipal plants are being installed. The effect in many of the towns and smaller cities will be to place two or more plants where there is room for but one. Probably in no previous year has the matter of economy been so carefully looked after, and any new ideas that may be presented at the convention will be thoughtfully considered by the members present.

In order that the members may have sufficient time for considering the different subjects that will be brought before the convention the secretary has furnished each member with a list of the topics for discussion. The following have been decided upon: "What is the most economical Size for Arc Dynamos;" "Arc Lights on Incandescent Circuits;" "How to Rate Arc Lamps;" "Underground Circuits;" "Commercial Alternating Motors;" "Electrolytical Effects of Return Currents;" "Meters vs. Flat Rates" and "Storage Batteries."

Other matters of interest will be presented through special papers. Messrs. T. C. Martin and L. Stieringer will contribute a paper on "Electric Lighting at the World's Fair and some of its Lessons" which will be illustrated by stereopticon views. "Impressions of a Central Station Man Abroad" will be presented by Mr. E. A. Leslie. Mr. J. H. Vail will discuss in a paper "The Importance of Complete Metallic Circuits for Electric Railways." "The Development of Switchboards for Modern Central Stations" is the subject of a paper prepared by Mr. A. B. Herrick,and a paper, the subject of which will be announced later, will be read before the convention by Mr. Chas. F. Scott. The following gentlemen have charge of transportation matters for the convention in their respective districts: A. C. Shaw, Boston, Mass.; C. F. Hesser, Cincinnati, O.; H. A. Cleverly, Philadelphia, Pa.; E. H. Heinrichs, Pittsburg, Pa.; M. J. Sullivan, Chicago, Ill.; Jas. I. Ayer, St. Louis, Mo.; E. R. Weeks, Kansas City, Mo., and W. W. Borst, Denver, Col.

The various passenger associations have granted a rate of a fare and one-third for the round trip from all points east of Chicago, Burlington and Peoria and the Mississippi River to Washington, D. C. Negotiations are now pending with the Western Traffic Association for members in that territory to secure this rate. By procuring of the ticket agent from whom the going ticket is purchased a Delegate Certificate to the National Electric Light Association meeting, which, when properly filled in and certified at Association Headquarters in Washington, a return ticket for one-third the regular fare can be secured.

The City of Washington.

The City of Washington possesses not only the advantages and conditions essential to the accommodation of a convention but many features which will make the visit one of pleasure and profit. As the capitol of the United States it is the seat of the government, where are located the different departments to which are entrusted the affairs of the country. The administration of affairs involving the interests of 65,000,000 of people attracts the attention of many visitors. To the American citizen there are also many places in Washington and vicinity of great historical interest.

It is perhaps with the expectation of deriving a great amount of pleasure as well as profit from the trip that the members set out for the convention. The orders for hotel accommodations indicate that a large number of the members will bring their families to the convention, thus recognizing the social side of the meeting. Many cities at which former conventions were held are strictly commercial cities whose busy factories, foundries and lines of transportation are the chief features. Washington is in no measure a manufacturing city. Its attractions are of an entirely different kind, possessing as they do as much interest to one's family as oneself. The government buildings with their halls, offices and contents, the public institutions, the National Museums, the avenues, parks and statues of the city, the National Cemetery, Navy Yard, etc., will permit of a series of enjoyable excursions.

On the opposite page are presented a number of views of the public buildings and institutions of Washington. The capitol occupies the commanding position of the city. The huge bronze statute of Freedom that surmounts the dome can be seen for miles, being at an altitude of 380 feet above the Potomac. In 1793 George Washington laid the corner stone of the original building which was destroyed by the British 21 years later. Besides the Halls of the Houses of Congress, the Chamber of the Supreme Court, the offices and committee rooms, the National Law Library which it contains, there will also be found paintings, statues and other works of art of great interest. The White House and the handsome grounds that surround it, covering some eighty acres, is another attractive point. The State parlors on the first floor are usually accessible to the public during certain hours of the day.

On F St. between Seventh and Ninth Sts., will be found the Patent Office whose records have so often been consulted since the beginning of the electrical industry. As a person enters the building he passes between the rows of immense columns of the entrance which was modeled after the Parthenon of Athens. The building is 410 feet by 275 feet and contains nearly 200 apartments besides the Museum of Models. The Treasury building on Pennsylvania Ave. and 15th St., possesses a great attraction to many. The cash room, vaults and Secret Service Bureau are the principal parts of interest. The State, War and Navy building also on Pennsylvania Ave. and 17th St. is one of the newer and more magnificent buildings of Washington and will well repay a visit. The building was completed in 1887 and is particularly handsome in the interior.

The post office building at E F 7th and 8th Sts. was commenced in 1839 and completed in 1867. The walls are of marble. From within these walls is directed the business of the post office department which aggregates over $45,000,000 per annum.

The largest bureau of the department of the interior is the Pension bureau, for the accommodation of which the Pension building was erected. It is 400 feet by 200 feet and from within its walls there is distributed over thirty million dollars per year. Washington also possesses many other attractive institutions. The Smithsonian Institute which ranks as the foremost institution of the country in the domain of science is situated in the center of a handsome park of 50 acres. The building is of red sandstone and has a length of 426 feet. The National Museum which stands to the east of the institute is under the same management, and contains extensive geological and industrial collections of the government.

The Corcoran Art Gallery at Pennsylvania Ave. and 17th St. is another institution that attracts much attention. The galleries contain several hundred paintings by American and European artists, magnificent collections of casts of antique marbles representing the work of the Greek sculptors and other valuable work. The public buildings are accessible to visitors from 9 a. m. to 2 p. m.

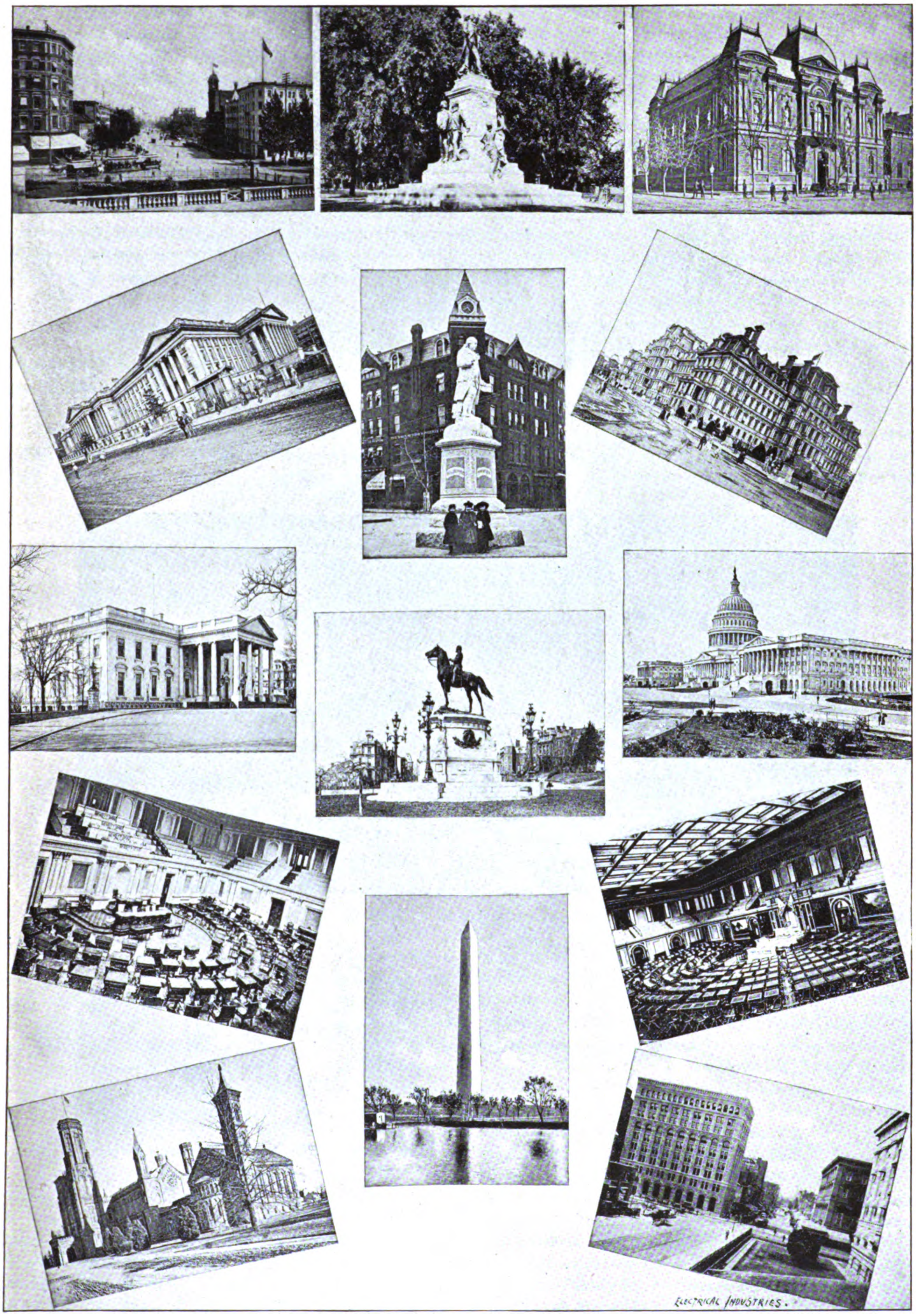
Electric Railways of Washington.

Washington has four electric railway systems besides its horse and cable lines. These lines have 51 miles of track, and in their equipment over two million dollars is invested. The Eckington & Soldiers Home Railway Co. was incorporated by an Act of Congress in 1888. It has 10 miles of standard gauge track, laid with 80 pound rails. The power station is equipped with three Armington & Sims engines, one Ball engine, and T.-H. generators. The motor cars are equipped with T.-H. 30-horse power and Westinghouse 50-horse power motors. The officers of the company are president, Howard Munnikhuysen; vice-president, W. Kesley Schoepf; secretary and treasurer, H. K. Gray; purchasing agent, W. K. Schoepf, and Mr. Robert I. Todd, superintendent.

The Brightwood Railway Co., started its system of electric traction in 1893. It has 12 miles of track laid with 78 pound girder and 50 pound T rails. The equipment of the motor cars is divided between the Westinghouse and General Electric motors, all being 50-horse power. The station has 364-horse power of Belmont, and 350-horse power of Woodruff engines. The generators will be of 540-horse power. The officers of the road are, president, Horace S. Cummings; vice-president, E. O. McNair; secretary, Victor B. Deyber; treasurer and manager, Chas. P. Williams; superintendent, Thos. O'Brien.

The Georgetown & Tennallytown Railway Co. has nine and one-half miles of track. Its power house is equipped with 400-horse power of T.-H. generators and 600-horse power of engines which are Frick-Corless and Ideal. The motor cars are equipped with two 15-horse power T.-H. motors. The officers are, president, M. Willson Offutt; vice-president, Bradley Davidson; secretary and treasurer, John E. Beal; superintendent, J. H. Mills. The Rock Creek Railway Company has 14 miles of track, a part of which is equipped with the overhead trolley and part with the underground. The track is standard gauge and is laid with 50 pound T and 90 pound girder.

The officers of the road are president, Francis G. Newlands; vice-president, Edward J. Stellwagen; secretary, Howard S. Nyman; treasurer, Thomas M. Gale and superintendent, Herbert Claude. The station is equipped with 800-horse power of T-H generators and engines of equal capacity. The cars are equipped with T-H motors of 15 and 25-horse power.



Pennsylvania Ave.
Treasury Building.
The White House.
The Senate Chamber.
Smithsonian Institute.

Lafayette Monument.
Franklin Monument.
Washington Monument.

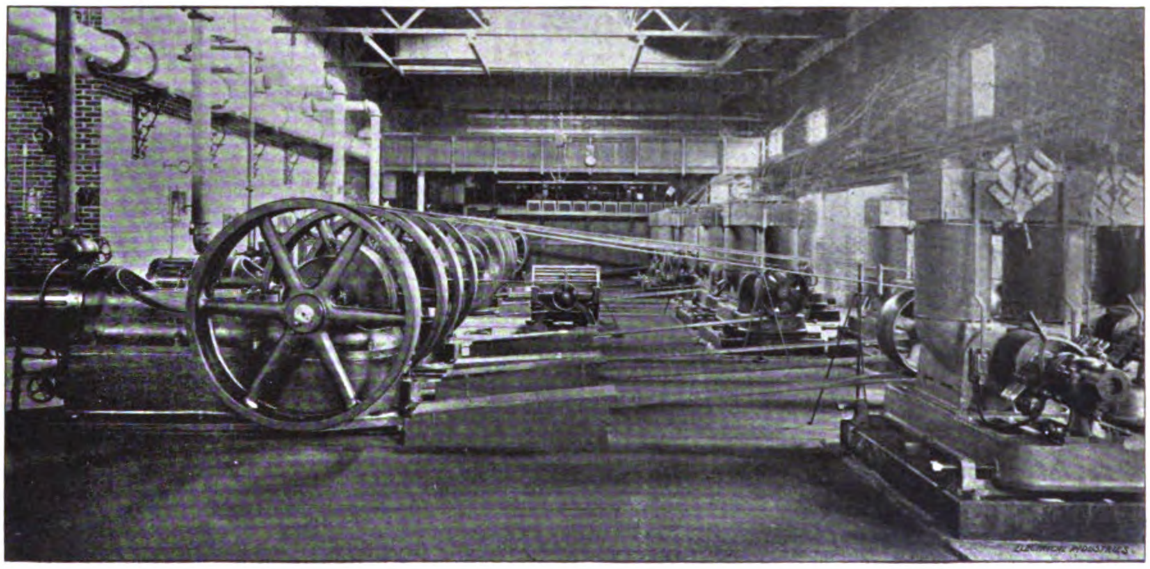
Corcoran Gallery.
State, War and Navy Dep't.
The Capitol.
Chamber of the H. of Rep.
From the Patent Office.

VIEWS OF THE CITY OF WASHINGTON.

Central Stations of Washington.

The oldest electric lighting company of Washington is the United States Electric Lighting Co., which furnishes the larger part of the lights of the city. The affairs of the company are directed by the following well-known business men: Mr. A. A. Thomas, president; Daniel B. Clark, first vice-president; W. E. Clark, second vice-president; Seymour W. Tullock, secretary and treasurer, and Frank H. Clark, general superintendent.

The company have a large and well constructed station and an extensive system of distribution. The station is located at the corner of 13½ and B streets, N. W. It is constructed of brick, with truss supported roof giving a large, clear floor space and a substantial construction. The accompanying cut shows the arrangement of one section of the station. The equipment includes six Armington & Sims 150-horse power engines, each belted to two 60 K. W. Edison bipolar dynamos; two 100-horse power Ideal engines, five 100-horse power New York Safety engines belted to T-H arc machines; one 50 and one 25-horse power Westinghouse engines belted to Brush and T-H machines; two 500-horse power compound condensing Green engines belted to four 150 K. W. bipolar Edison dynamos; one 250-horse power compound condensing Green engine belted to four 50-light T-H arc dynamos; two 200-horse power non-condensing engines, each belted to a 2,000 light T-H alternator.



CENTRAL STATIONS OF WASHINGTON.

The steam is generated in eight return tubular Coleman boilers at 90 pounds, two Cambell & Zell water tubular boilers at 90 pounds, and in six National water tube boilers at 130 pounds. This station supplies current for 29,325 incandescent lamps, 3,000 of which are supplied with alternating current and the others direct. Arc lamps to the number of 557 are also run from this station, of which 330 are furnished the city. The lights are distributed throughout the District of Columbia by an extensive system of underground distribution constructed of glazed terra cotta conduit into which lead covered cable is drawn. All the alternating current circuits are placed underground and the larger part of the others. There are a few commercial arc lights operated from an overhead system and a few direct current incandescent.

The company also supplies service for 330-horse power of motors from which it derives a considerable revenue.

Washington has another central lighting station owned by the Potomac Electric Company, which is now operated by the receiver, Mr. H. W. Sohen. The station has an excellent equipment consisting of one 275-horse power Armington & Sims high speed, compound condensing, using Davidson's condensors and pumps; three 80-horse power Union Iron Works boilers that were installed by Mr. J. B. Gordon, of Georgetown; Westinghouse alternators of a capacity of 1,250 incandescent lights, and one 50-light Western Electric Co.'s arc dynamo. The officers of the company are president, Mr. J. E. O'Gorman; vice-president, J. W. Baird; treasurer, H. P. Gilbert; secretary, Neal DuMont; superintendent and general manager, M. J. O'Donnell.

Electric Houses of Washington.

The principal dealer in electrical supplies in Washington is the firm of Royce & Marean, which is also a large contractor for electrical installations. This firm has followed this line since the inception of the industry. By careful and conservative methods the extensive business that it controls has been built up, and the large trade, which includes many government contracts, now extends over the United States. Telephone and telegraph construction also forms part of their business. The members of the firm are very popular with the trade. Mr. F. W. Royce is an old time telegrapher, and saw service in the late war. Mr. Morell Marean was also a telegrapher and occupies at the present time a high position in the Western Union service, having charge of the Washington office.

The Ebbitt House—The Headquarters of the Convention.

The Ebbitt House selected for the headquarters of the Association during the Convention is one of the most widely known hotels of Washington. It has been the favorite stopping place especially for those connected with the army and navy. Its central location places its guests in easy access of any part of the city. A five minutes walk will take one to the Treasury, the War, Navy, and State or the Pension building, while cars pass the door for any other part of the city. Grand Army hall where the meetings of the Association will be held is within one block of this hotel.

The hotel is most excellent in all its appointments. It is heated by steam and lighted by electricity. The open grates with which the hotel is generously supplied give an air of comfort and cheerfulness to the apartments. Private baths and everything that will add to the health and comfort of the guests is provided. The dining room is bright and cheerful and the cuisine is unexcelled. Mr. H. C. Burch, the general manager, who is well-known to visitors to Washington, is a sufficient guarantee of the royal entertainment that will be accorded all delegates and their friends.

THE EBBITT HOUSE.—HEADQUARTERS DURING THE CONVENTION.

Love Underground Trolley System on Rock Creek Ry.

In making an excursion to the Zoological Gardens an opportunity will be offered, if you go by street cars, of inspecting the Love underground trolley system in use on a section of the Rock Creek railway. This system which is the first successful underground electric system so far employed in this country is well worthy of a visit. Its operation for an entire year has subjected it to the varying conditions of the different seasons of the year. Experience has been gained in its operation and the defects found in other roads have been remedied in this. No fault has been found with the insulation nor any delay caused by leakage, although there has been many bad storms both of snow and rain.

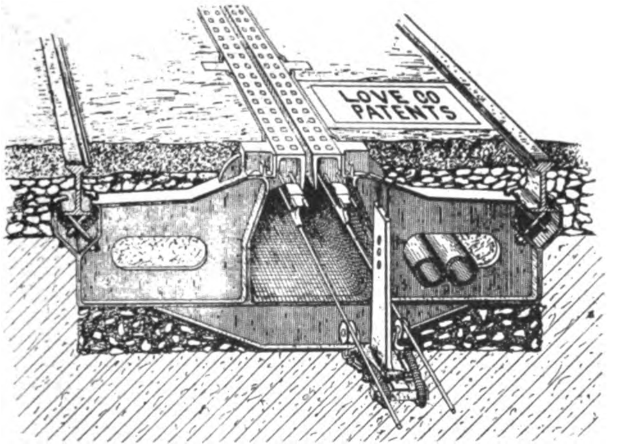


FIG. 1.—LOVE UNDERGROUND TROLLEY SYSTEM ON ROCK CREEK RY.

The underground system is used from 7th St. to U. and 18th Sts. where the overhead system is used. The time consumed at this point in tying down the trolley arm and putting in the undergound trolley is from 15 to 25 seconds. A ride over this road enables one to compare the two systems.' The first noticeable advantage of the underground system is the absence of all overhead wires, poles, etc. The beauty of the street is unmarred. There is no liability of other wires falling across the trolley wires. The use of a metallic circuit gives greater efficiency to the system, prevents the destruction by electrolysis of the underground pipes and reduces to the slightest degree the inductive effect on neighboring lines. The current saved is estimated at frcm 20 to 30 per cent.

A thorough inspection of the line will undoubtedly convince the most skeptical of the merit of this system. The expansion and contraction of the trolley wires and slot rails have been well looked after since no inconvenience or damage has resulted from the changes of temperature which range from 8 to 122 degrees F. It is claimed that to this cause is due the frequent breaking of insulators but on this line the insulators move with the wire and therefor are subject to no strain. Although many of our readers are familiar with the construction of the system, a short description may be to some of interest.

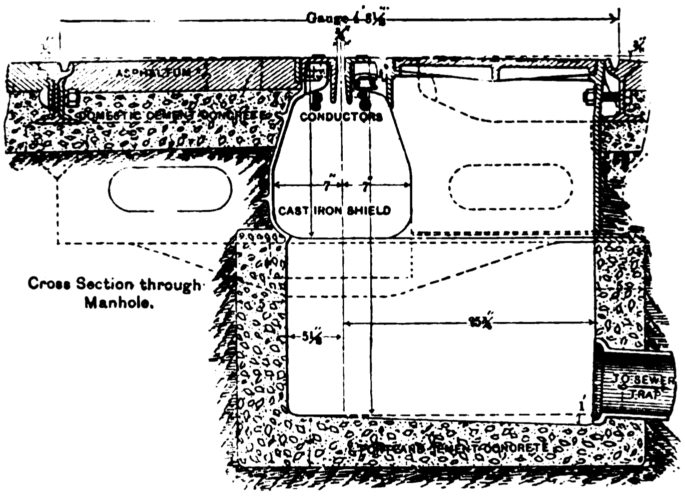


FIG. 2.—LOVE UNDERGROUND TROLLEY SYSTEM ON ROCK CREEK RY.

The excavation required is slight, not sufficient to require any interference with the pipes in the street. The yokes as shown in the accompanying cuts weigh 360 pounds each and have an opening 20 by 14 inches. They are square at the ends to support the rails and are embedded in concrete so that the entire track construction is extremely solid. The conduit is continued between the yokes and at intervals of 100 feet manholes are constructed with leads to the sewer, giving a good drainage to the conduit. Snow, dust, and whatever matter may collect in the conduit is swept into these manholes by a broom which fits the conduit. From the manholes it is easily removed. The slot rail that is attached to this yoke is made of steel. It is V shaped and has a side bearing of an inch and a half and projecting into the conduit five inches on the inner side. The insulator is attached to the yoke upon shouldered bolts in such a way as to give it a lateral freedom of two and one-half inches.

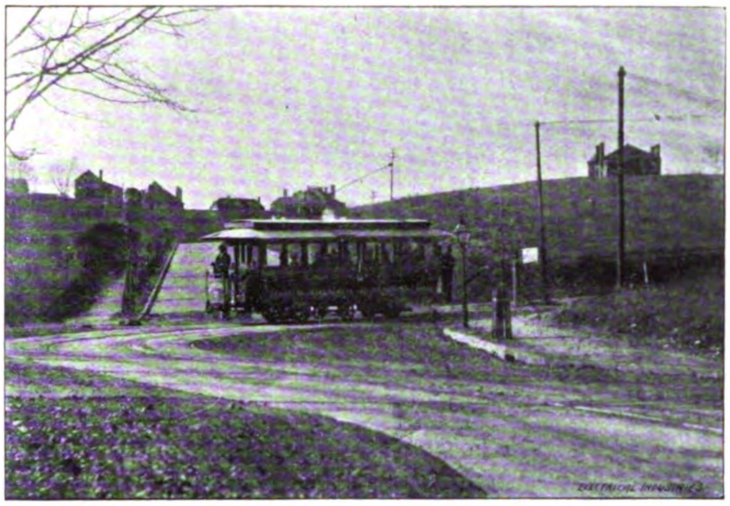


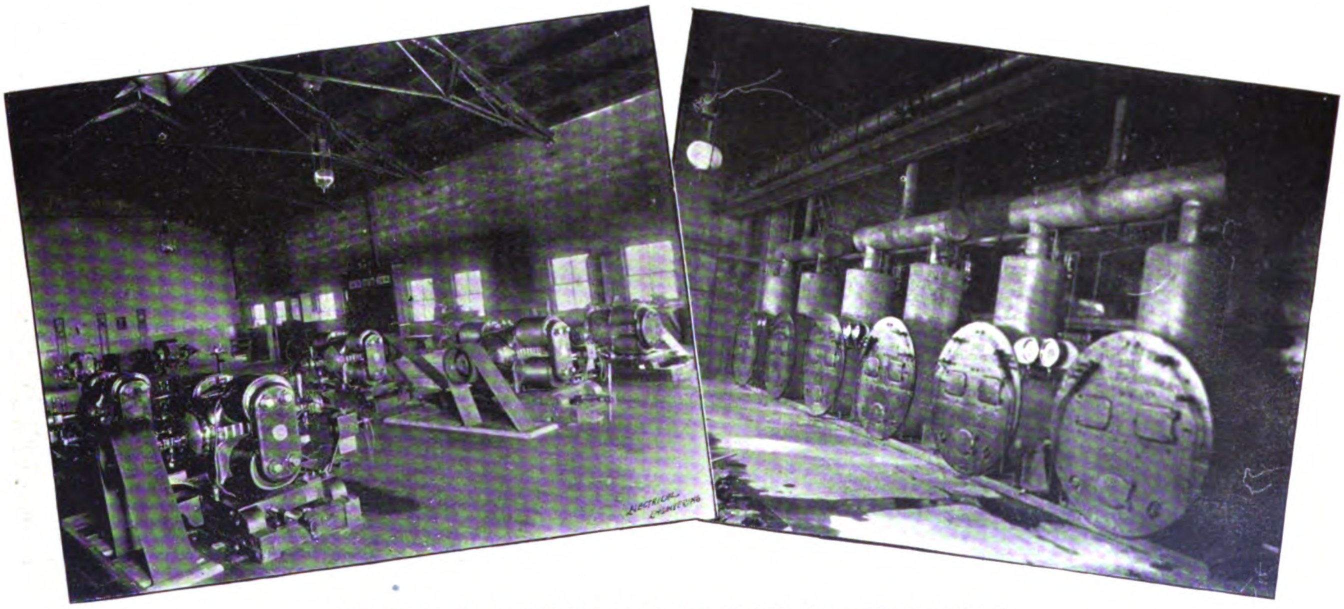
FIG. 3.—LOVE UNDERGROUND TROLLEY SYSTEM ON ROCK CREEK RY.

The slot rail is easily removed and exposes the trolley wire and insulators for repair or adjustment. The trolley support is made of half inch steel, four and one-half inches wide with two trolley arms suitably insulated. It is shaped in the center to allow the trolleys to move sideways so that if the wire is not exactly straight it prevents the binding or straining of the wheels and wire. In rounding curves it runs as smoothly as on straight runs. The operation of the cars is entirely mechanical and requires no great electrical knowledge. The line has been examined by many American engineers and was also visited by a number of prominent foreign engineers during the past summer and elicited praise from all as being a highly satisfactory system. The company operates 14 motor cars on this line.

Municipal Lighting in Chicago.

The subject of municipal lighting has received considerable attention during the past few years and by many the opinion has been held that municipal lighting could not be made to pay but on the contrary would result in a loss to the city or town. The question is still open to discussion since the advocates of either side of the question can find facts to substantiate their statements. While there are many cities with a system of electric lighting that costs more than the contract price of a private company in the same city, there are other municipal plants that are making very favorable showings. There are more new municipal plants planned for the coming year than during any year since the inception of the industry. Why this is so is not quite clear but a number of solutions are plausible.

It is a common belief that city governments are expensive business managers. On the other hand are city governments as black as painted? The American method of conducting a political campaign does not bring out the good of the government but that which is bad in the incumbent or in the aspirant for the political honor. Publicity is at once given to the deeds of the rogue but the more honest man is unknown outside of his circle of acquaintances. Under such methods municipal governments have received a bad name. The fact remains, however, that while some plants are economically run others are both inefficient and expensive. An interesting report has just been completed by Prof. J. P. Barrett, city electrician of Chicago, of the cost of operating the municipal electric lighting plants of that city. The accompanying table shows the expense of each station for the year ending December 1, 1894. The different items of expense are specified showing the relative amounts charged to each. The average cost of operating a lamp from each station per hour and the average cost per lamp from the entire system has been figured out in this report. The results, to say the least, compare very favorably with that of any station where prices are the same.



FIGS. 1 AND 2.—MUNICIPAL LIGHTING IN CHICAGO.—STATION NO. 1.

The following table gives the total number of hours operated, the total number of lamp hours and the cost per lamp hour.

	HOURS OPERATED.	LAMP HOURS.	COST PER LAMP HOUR.
Plant 1......	3,971	1,389,500	.0244
" 4......	3,925	1,204,975	.0226
" 6......	4,056	1,435,824	.0235
" 8......	3,987	352,803	.0307
		4,383,102	.0244

The necessary data for securing these results is secured from the daily reports made out each day by the chief engineer of each station. Blanks are furnished for these reports which have been made up after a number of years of experience in the management of these stations. One of these blanks is reproduced for the benefit of the reader.

The cost of $96.00 per lamp per year would be high where lamps are burned on the moonlight schedule and not burned during the early morning hours, but these lamps are burned every night and all night. The moonlight schedule for February calls for 190 hours, which at the above average cost per lamp hour would be $4.63 per lamp for the month. This schedule calls for lights up to 6-10 A.M, on dark nights, but should the lights be extinguished at 1-30 A.M. as in many of the smaller towns, the $4.63 would be reduced to $3.00. It is a question, however, whether that rate could be maintained on such short hours.

These figures are based on the operating expenses, interest, depreciation, etc., not being included. There has up to the present time been invested in the plants of the city $688,312.80 which includes land, buildings, underground systems, lamps, posts, steam and electrical equipments, etc. The future requirements of the stations have in every case been looked out for; the conduits have been substantially put down; the lamps and posts have been selected not with reference to cheapness but service, and of neat outlines that would make them an ornament in the street. Few municipal plants have a system as substantially built.

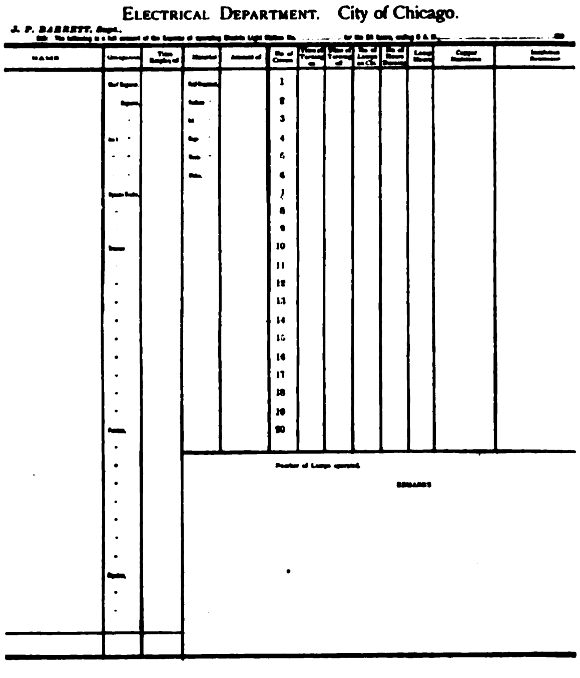
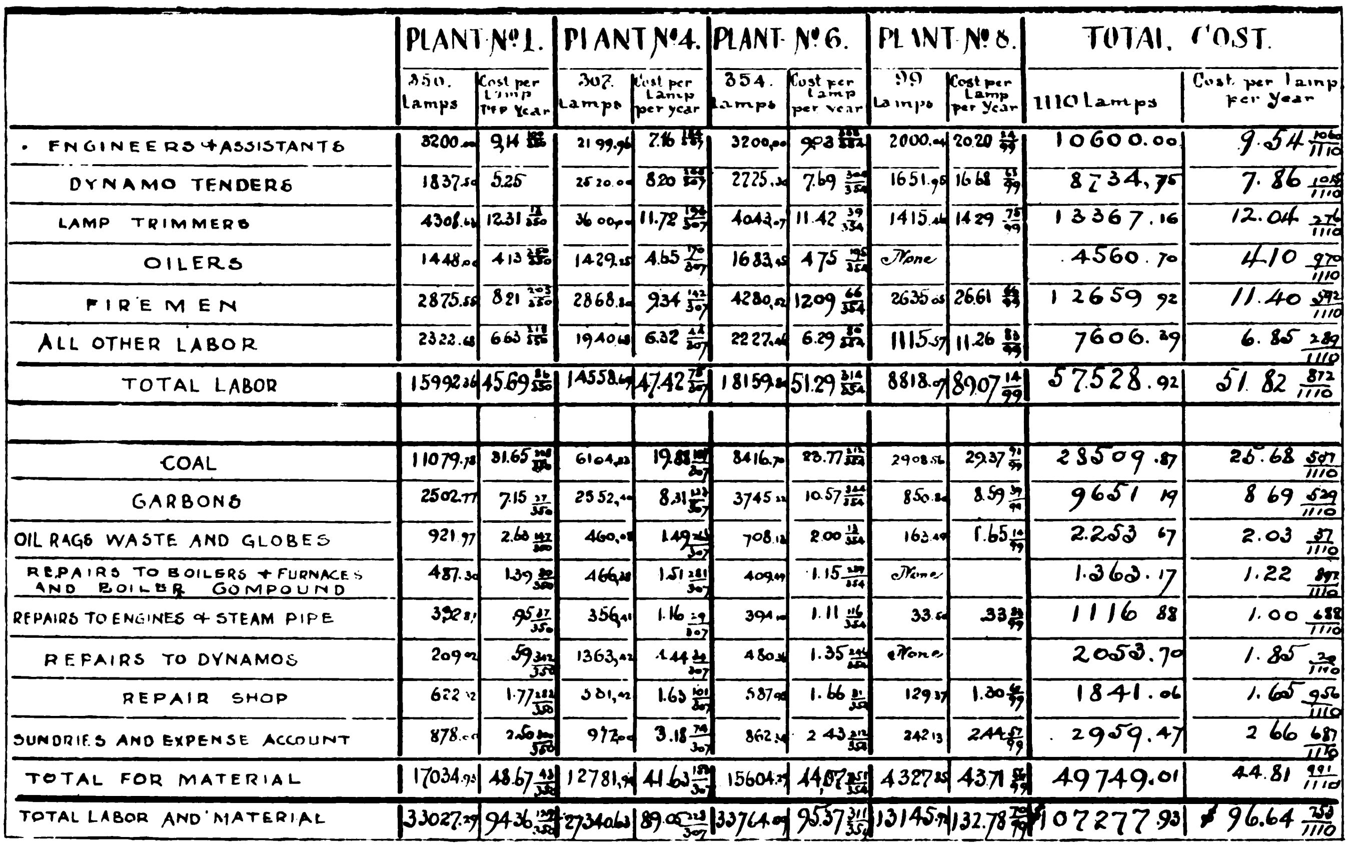


FIG. 3.—MUNICIPAL LIGHTING IN CHICAGO.—BLANK REPORT.

The city now operates but three plants, one in each of the divisions of the city, as the Chicago river divides it. One of these stations has been sold with the equipment to the Metropolitan Elevated R. R. Co., which road crosses the property. The fourth station operated a part of last year is now used for another purpose, and the machinery has been placed in the other stations. Plans have not been made for the erection of a station to take the place of the one sold, which will probably be built on the lots received from the Metropolitan road on Polk St.



	PLANT No. 1.		PLANT No. 4.		PLANT No. 6.		PLANT No. 8.		TOTAL COST.	
	350. Lamps	Cost per Lamp per Year	307. Lamps	Cost per Lamp per year	354. Lamps	Cost per lamp per year	99 Lamps	Cost per Lamp per Year	1110 Lamps	Cost per lamp per Year
ENGINEERS & ASSISTANTS	3200.00	9.14 100/350	2199.96	7.16 184/307	3200.00	9.03 338/354	2000.00	20.20 20/99	10600.00	9.54 1060/1110
DYNAMO TENDERS	1837.50	5.25	2520.00	8.20 260/307	2725.36	7.69 310/354	1651.98	16.68 66/99	8734.75	7.86 1015/1110
LAMP TRIMMERS	4308.64	12.31 14/350	3600.00	11.72 196/307	4043.07	11.42 39/354	1415.46	14.29 75/99	13367.16	12.04 276/1110
OILERS	1448.00	4.13 250/350	1429.25	4.65 170/307	1683.05	4.75 155/354	None		4560.70	4.10 970/1110
FIREMEN	2875.58	8.21 205/350	2868.80	9.34 142/307	4280.52	12.09 66/354	2635.05	26.61 66/99	12659.92	11.40 592/1110
ALL OTHER LABOR	2322.68	6.63 218/350	1940.68	6.32 44/307	2227.46	6.29 80/354	1115.57	11.26 83/99	7606.39	6.85 289/1110
TOTAL LABOR	15992.36	45.69 86/350	14558.69	47.42 75/307	18159.80	51.29 314/354	8818.07	89.07 14/99	57528.92	51.82 872/1110
COAL	11079.78	31.65 208/350	6104.23	19.88 107/307	8416.70	23.77 212/354	2908.56	29.37 93/99	28509.87	25.68 507/1110
CARBONS	2502.77	7.15 27/350	2552.44	8.31 127/307	3745.22	10.57 344/354	850.78	8.59 37/99	9651.19	8.69 529/1110
OIL RAGS WASTE AND GLOBES	921.97	2.63 147/350	460.08	1.49 265/307	708.12	2.00 12/354	163.49	1.65 14/99	2253.67	2.03 37/1110
REPAIRS TO BOILERS & FURNACES AND BOILER COMPOUND	487.30	1.39 80/350	466.28	1.51 281/307	409.49	1.15 239/354	None		1363.17	1.22 897/1110
REPAIRS TO ENGINES & STEAM PIPE	332.81	.95 31/350	356.41	1.16 29/307	394.00	1.11 106/354	33.50	.33 83/99	1116.88	1.00 688/1110
REPAIRS TO DYNAMOS	209.02	.59 252/350	1363.42	4.44 34/307	480.36	1.35 246/354	None		2053.70	1.85 20/1110
REPAIR SHOP	622.12	1.77 262/350	501.42	1.63 101/307	587.[illegible]	1.66 81/354	129.37	1.30 67/99	1841.06	1.65 956/1110
SUNDRIES AND EXPENSE ACCOUNT	878.00	2.50 300/350	977.00	3.18 74/307	862.34	2.43 212/354	242.13	2.44 57/99	2959.47	2.66 687/1110
TOTAL FOR MATERIAL	17034.95	48.67 45/350	12781.94	41.63 153/307	15604.77	44.07 251/354	4327.85	43.71 56/99	49749.01	44.81 991/1110
TOTAL LABOR AND MATERIAL	33027.29	94.36 129/350	27340.63	89.05 228/307	33764.09	95.37 311/354	13145.92	132.78 70/99	107277.93	$96.64 250/1110

FIG. 4.—MUNICIPAL LIGHTING IN CHICAGO.—TABLE OF EXPENCES.

The history of municipal lighting in Chicago commenced in 1887, when the first city plant was installed in the basement of the Fire Department engine house at the corner of Clinton and Washington Sts. This plant consisted of four 30-light dynamos and 125-horse power of engines. The lights, which were low-tension, were located at the ends of the bridges and viaducts. Fifteen miles of circuits were placed underground in two inch iron pipe for these lights. The next year the plant was installed in the engine house at 195 S. Jefferson St., the equipment being moved from the former station. The plant was enlarged to 425-horse power of engines and thirteen 30 light dynamos. The lamps were increased to 279 and 50 miles of circuits were placed underground.

It was soon after this that the city authorities decided to extend the system of city lighting and the city lighting department prepared a plan of stations and systems of distribution. The city was laid out into 12 districts; near the center of each a station was to be erected and a system of distribution constructed for lighting that district. In laying the conduit space was to be provided for the wire of the police and fire alarm systems. It has been in accordance with this plan that the city stations have been erected.

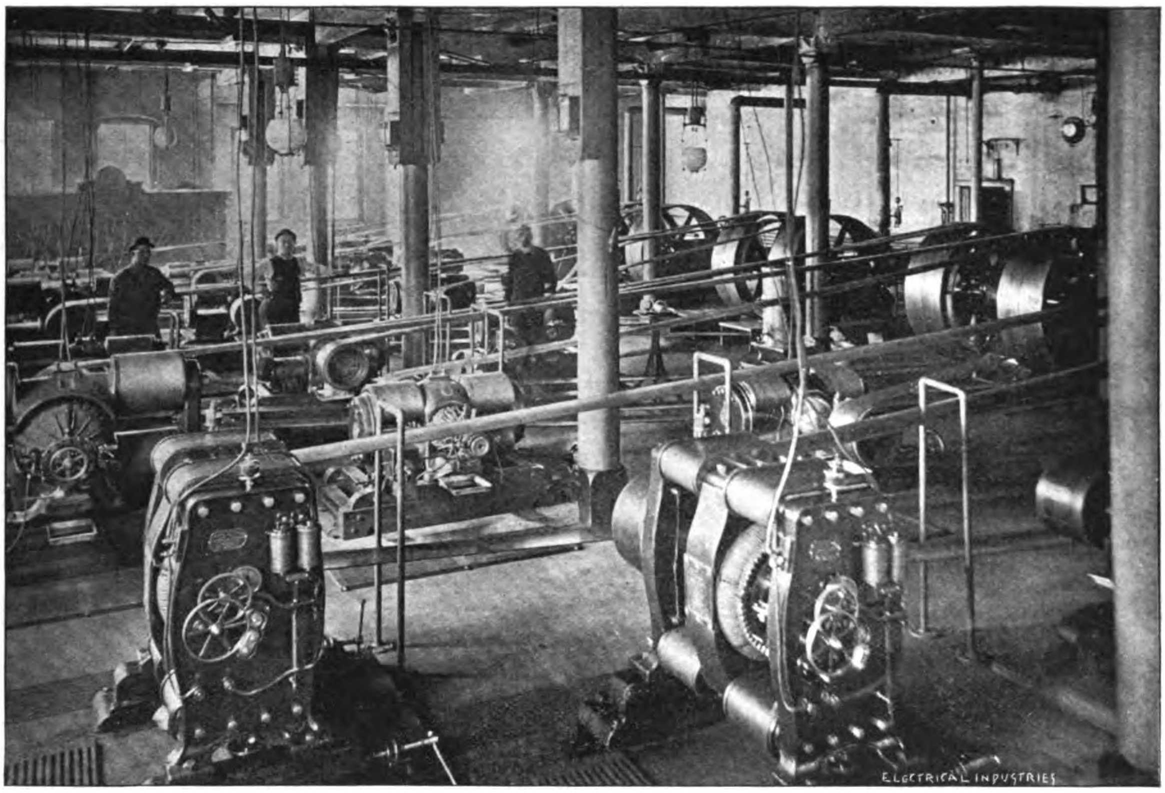


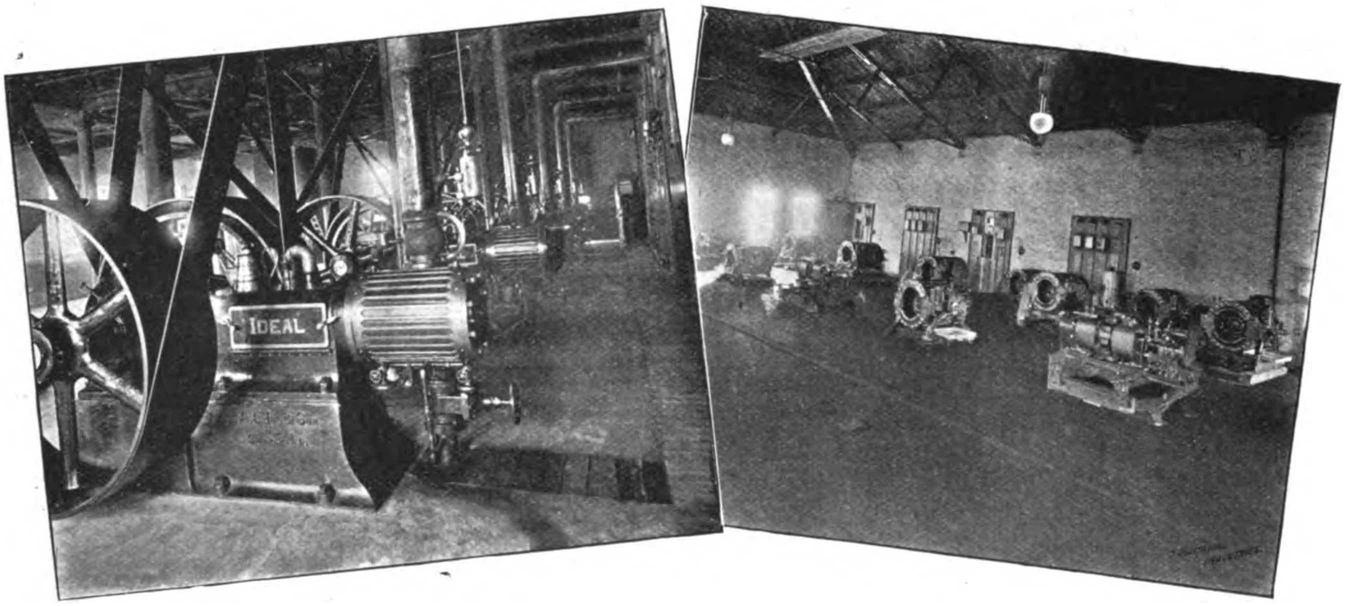
FIG. 5.—MUNICIPAL LIGHTING IN CHICAGO.—STATION NO. 4.

The station for district No. 1 was erected in 1890 at the corner of Indiana Ave. and 14th St. The building was substantially constructed of sufficient size to accommodate a plant of 850 arc lights. The walls are of pressed brick and stone, two stories in height. The engine and boiler rooms are on the ground floor, while the dynamo room is on the floor above the engine room. The lower floor is of concrete and the upper is double laid with three-inch matched flooring. The steam plant consists of six 100-horse power Portland boilers with down draft furnaces hand fired, using Indiana Block coal. A single and a double Blake pump pumps the water into the 1,000-horse power Berryman exhaust steam feed water heater, which heats the water to about 200 degrees before it enters the boiler. The engines consist of a 275-horse power automatic cut-off Wright engine running at 70 revolutions per minute, with cylinder 24 by 42 inches. The fly wheel, 15 feet in diameter is belted by a 36-inch belt to a line of shafting fitted with pulleys and friction clutches operated from the dynamo room above. There are also one Buckeye high speed engine with 14 by 16-inch cylinder and two Ideal engines with cylinders 14 by 14. The dynamo room contains seven 60-light Western Electric arc dynamos of which five are belted to the shaft and the other two to engine. The whole is so arranged as to shift the load from any engine or set of engines to any other. The district covered by this station reaches from the river as far south as 22nd St.

The station for district No. 4 was constructed on E. Chicago Ave., of brick, two stories in height, and the plant placed in operation on Feb. 22d, 1890. The station is designed to accommodate an equipment for 1,000 arc lights. The engine and boiler rooms are on the ground floor, similar to station No. 1. The boiler plant consists of four 125-horse power boilers equipped with mechanical stokers and smokeless furnaces. The five 125-horse power Ideal engines are automatic high speed with cylinders 14 by 14 inches. Each engine has two driving pulleys 68 inches in diameter and 22-inch face which are belted to the dynamos on the floor above. Eleven T.-H. and four Brush arc machines furnish current for the lights on this system.

A few months after station No. 4 was started station No. 6 was ready for use. The station is located on Throop St., near Van Buren St., and is about the same size and style of construction as the former station. Three 64-inch by 18 feet and four 68-inch by 18 feet tubular boilers furnish the steam for the operation of the plant. The boilers are fitted with mechanical stokers and smokeless furnaces. The engines and dynamos are both on the ground floor. The engines are 125-horse power automatic high speed with cylinders 14 by 14. A dynamo is belted to each pulley. The dynamos are of the Western Electric and Wood type. Station No. 8, which has been turned over to another department of the city was similarly equipped. The underground system in each district has been constructed for the lighting of the entire district.

Electric lighting forms one division of the electrical department of the city, and as city electrician in charge of the electrical department Prof. Barrett has given his personal attention to the installation and operation of these lighting stations. The task of securing an efficient and economical lighting system has been by no means easy. The usual impediments to public improvements have been encountered, to which has been added many special causes, making the enlargement os the system slow. Mr. D. M. Hyland and Mr. Wm. Carroll are in direct charge of the various plants and are thoroughly conversant with the details of the system.



FIGS. 6 & 7.—MUNICIPAL LIGHTING IN CHICAGO.—STATION NO. 6.

Electric Lighting Plant at South Norwalk, Conn.

The report of the electric light commissions having charge of the municipal electric lighting plant of the city of South Norwalk, Conn., presents a very good showing for the year. The system was built under the direction of a committee appointed by the city, and it is operated under the direction of three commissioners, one of whom is elected each year for a term of three years. The plant and system were constructed under a capable engineer. On a lot purchased for the purpose a fireproof building was constructed, 40 by 66 feet. The building is divided by a fire wall into two parts, a boiler room and an engine room. It affords abundant room for present needs and future additions. The boiler room contains one 125-horse power tubular boiler. The feed water is heated by a 200-horse power feed water heater, and other appliances are also provided giving economical results in the generation of steam.

In the engine room is located a 100-horse power Ideal high speed engine to which there are belted two 60-light arc machines. The city is lighted by 96 arc lights placed at the street intersections, two circuits from the station covering the district. The electrical equipment was furnished by the Western Electric Co., of New York and Chicago. The station is arranged for double its present equipment without any alterations. The number of lights may be increased about 25 per cent on the present equipment. The cost of the station is as follows: Real estate, $6,117.73; steam plant, $4,285.50; electric plant, $9,399.75; new construction, $1,130.25; tools and equipment, $640.30, making a total of $21,573.53. The cost of operating the plant is divided as follows: Labor, $2,395; expenses, including coal, oil carbons, etc., $1,740.03; repairs, $95.00; tools and equipment, $363.81, a total of $4,594.84. An average cost of operating (90 lights being used) each lamp per night of less than 20 cents or $51.05 per light per year. Adding to this amount eight per cent for interest and depreciation on investment or $1,725.88 equals $6,320.72 or $70.23 per light per year. The lights are started at dusk and are burned until 1:45 A.M. On clear moonlight nights the lights are not used.

The B. & O. Special from Chicago to the Convention.

The Chicago delegation will go to the Washington convention over the B. & O. R. R. The train will leave the Grand Central Station, corner Fifth Ave. and Harrison St. at 6:25 P. M. the 25th. Unless all signs fail a large number of electrical people will avail themselves of this opportunity to attend the convention and see the city of Washington, which abounds in so much of interest to everyone. The train will be made up of Pullman sleepers of the newest type with a dining car attached, upon which all meals will be served to the delegates en route. The management of the road will, in fact, spare no pains or effort to give the delegates every convenience, all of the details of which will be looked after carefully by the officials of the road. The selection of this route is especially fortunate as the route is a popular one to Washington, being, in fact, the only one running through trains to that point. It is known as the picturesque line and runs through some of the finest mountain scenery in the United States. The rate of a fare and a third has been secured from Chicago and other points throughout the territory covered by the Central Traffic Association. Tickets should be secured at the city ticket office of the B. & O. road at 193 Clark St., where delegates paying full fare going will receive a certificate, which when properly signed, will entitle the holder to one-third of the regular fare for the return trip. Mr. M. J. Sullivan, 936 Monadnock Block, has been appointed to look after the arrangements for delegates in Chicago and vicinity to whom correspondence may be addressed and applications made for sleeping car accommodations.

Electrical Industries.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

Advertising Rates upon application.

Since the announcement made in our last issue we have removed our offices from 1409 Monadnock Block to 1428, 1429 and 1430 of the same building, the new quarters being located on the same floor and fronting on Dearborn street. We are getting settled as fast as possible and are well pleased with the new location. We cordially invite all our friends to drop in and see us.

The illumination of the grounds of the Mid-Winter Fair, was successfully accomplished for the first time on the evening of the opening day, January 27th. The outlines of the buildings are lighted similarly to those at the Columbian Exposition, except that the lights are run in series instead of multiple, and the grounds are lighted, with arc lights. The success of these methods of illumination has proved their fitness. The managers of this department at the Fair have been very successful from an economic point of view in securing the plants and lights. The four companies whose apparatus furnishes the lights have placed the plants as working exhibits. The interiors as well as the exteriors of the buildings are illuminated from this source. It is said that the total cost to the Fair company is but one and one-half dollars per light.

Should the courts sustain the Berliner patent, congress could find no more beneficial employment than a revision of the patent laws. That the patent office should grant a patent involving principles covered by patents previously granted, allow important changes to be made in the specifications and drawings after the application was filed, and most of all allow almost a decade and a half to elapse between the filing of an application for a patent and the granting of the patent, should warrant at least an investigation which would discover to whom or to what such results are due. The patent laws have stimulated and encouraged invention, but they have also protected monopolies and permitted them to reap enormous profits. It is an exception when the inventor reaps the rewards. Seventeen years is the life of a patent, and is long enough to give an inventor a suitable return for his labor. Were the patent laws so modified that the period which the patent is to run should date from the filing of the application, a repetition of the Berliner case, with its attendant expense and uncertainty, would not occur.

To the convention is a trip that central station men and those interested in the commercial side of electricity are preparing to take. As the merchant or manufacturer goes to the centers of trade to learn of the goods on the market, or of the business of the coming year, the commercial producers of electricity will meet the men of this progressive industry at this convention, and discuss such questions as concern this line of business. The experience and study of one man amounts to but little, when we consider the present status of the industry. It is by combining that of many that the industry has expanded and grown to its present grand proportions, each convention making a step in the advancement. This, the seventeenth convention, will undoubtedly bring out more of interest and value than any previous convention. The year 1893 has been remarkable for many events which have given a new coloring to this industry. Theories have become facts; new applications of electricity have been made and the old extended; electric lighting has been more firmly established as an industry; the manufacture and supply of electrical machinery has been greatly simplified, and a greater efficiency secured in the generation and distribution. The facts concerning the use of electricity have become better known to the public. Everything indicates a large attendance at the convention. Pleasant accommodations have been secured from both New York and Chicago. Every arrangement for comfort and convenience has been made in Washington. The subjects to be discussed by the convention have been furnished to the members and those likely to attend. Electrical Industries will be pleased to meet its friends at the convention, and urges all who can possibly go to attend.

On January 30 the patent of the Bell receiver expired. The expiration of this patent and that of the fundamental Bell patent, which expired on March 7, 1893, removes the barrier which heretofore has given the monopoly of the telephone business in the United States to one company. The public can now manufacture a telephone which will do good service at least over limited distances. It must not be understood, however, that the field is entirely clear. The American Bell Telephone Company owns a number of patents which cover parts of the telephone, shape, methods of manufacture, etc., and in the construction of telephones these patents should be carefully studied. The most valuable are those which relate to the central office or exchange. For seventeen years this company has held a monopoly of the telephone interests, and in that time has so thoroughly intrenched itself that it will continue to control the bulk of the telephone business. In the larger cities and the long distance service the company's business will remain unchanged for some time at least. Among the smaller cities and for private use there is a large field open for a good telephone. A good telephone for private use will be welcomed among people to whom the yearly tax and restrictions of the Bell company were distasteful. For some time, in anticipation of the expiration of the Bell patents, there has been a number of companies organized and preparations made for the manufacture and sale of telephones. Franchises have been secured and everything prepared for the construction of a number of exchanges the first of February. The complete solution of the telephone situation cannot be had until the result of the suit brought by the Attorney General to annul the Berliner patent is carried through and it is determined whether the Edison patent issued May 3, 1892, is valid. It is thought that the suit to annul the Berliner patent will be pushed through as fast as possible and a decision reached at an early date. Other cases similar to that of the Edison patent, which involves the relation of an American patent to a foreign one, are being tried, and the decision reached in those will probably determine the fate of the latter.

A History of the Telephone.*

BY W. CLYDE JONES.

It was in 1819 that Oersted, a professor in the University of Copenhagen, while lecturing to his class, discovered that a magnetic needle, when held in the vicinity of a wire, traversed by an electric current, was caused to assume a position at right angles to the axis of the wire. This experiment confirmed the long standing suspicion that electricity and magnetism were, in some mysterious manner, related.

Oersted had informed the world that there was a relation between electricity and magnetism, but it remained for Sturgeon in 1825 to point out that there was not only a relation, but that electricity was even convertible into magnetism. He had encircled a bar of soft iron with a helix of wire and noted that upon the passage of an electric current through the helix, the soft iron bar assumed the properties of a magnet. Here was the germ that was afterward developed into the telegraph and the telephone. With the electromagnet, the minds of men naturally turned to the transmission of intelligence to a distance.

The dormant hope was aroused by the publication of the researches of Joseph Henry, who had so thoroughly investigated the laws of the electromagnet that no discoveries except of minor importance have resulted from later investigation; in fact the electromagnet as Henry knew it in 1830 is the electromagnet as we know it to-day. Ever since Sturgeon had converted electricity into magnetism, the question ever uppermost in scientific minds was whether magnetism might not in turn be converted into electricity. It was in 1831 that Henry and Faraday discovered that magnetism was, in fact, convertible into electricity and was effected by varying the magnetic field threading a looped conductor. By this discovery, the world acquired the information concerning the laws of electromagnetism, and the mutual convertibility of the two mysterious forces.

The time was now ripe for the development of the electric telegraph, and in the early thirties Samuel F. B. Morse had conceived the electric telegraph, which toward the end of the decade, assumed practical form. Naturally, the operation of the Morse telegraph suggested the possibility of transmitting the voice itself to a distance, and indeed, as early as 1854 we find Charles Boursel publishing to the world the possibility of speech transmission in words that have since become historic.

Boursel erroneously supposed that the voice could be transmitted by the opening and closing of the circuit and thus outlined a path of research which science traveled for twenty years until Bell by his theory of electric undulations removed it from the deeply worn rut. In 1861 Philip Reis, of Frankfort, Germany, apparently following the instructions of Boursel, constructed the first telephone which comprised as a transmitter a diaphragm, adapted in its vibration to open and close an electric circuit.

By comparing the telephone of Reis with the telegraph of Morse, it will be observed that the transmitting instruments differ only in that Morse used a key actuated by the hand for opening and closing the circuit, while Reis provided a diaphragm, which for the sake of the analogy we may consider a key adapted to be actuated not by the hand but by the vocal organs. Again, the only essential difference between the receiving instruments was that Reis had applied to the armature of the Morse instrument a thin plate for the purpose of setting the air particles in motion. Reis by opening and closing the circuit was unable to transmit the complex current undulations upon which we know the transmission of articulate speech to depend, and was only able to transmit simple musical sounds.

There is a remarkable resemblance between the receiver of Reis and the magneto telephone of Bell, the difference being that Bell secure the thin plate by its edges, and provides the armature at its centre while Reis mounts the plate upon a horizontal axis and places the armature upon one end. In both, the function of the plates is to beat the air, in both, the function of the magnet and armature is to set the plate in motion.

We see, therefore, that Reis actually had a receiver capable of reproducing articulate sounds, had he but understood the necessities of the transmitter, and that by adjusting his transmitter so that the contact would remain continuously in contact, he would have had an articulating transmitter. With apparatus of such possibilities, it does, indeed, seem remarkable that the mere oversight of not having turned a screw a fractional rotation on its axis, or of not having connected two particular binding posts by a wire, should have shifted the honor of having first transmitted articulate speech from the shoulders of Reis to those of men living half a generation later.

The apparatus of Reis, as Reis used it, was incapable of transmitting articulate speech since the only effect of each vibration of the diaphragm was to close the circuit of a battery and send a current impulse over the line. These current impulses being always of the same strength the viabrating plate of the receiver always produced tones of a given loudness; but as the rate of vibration of the transmitter varied, the rate of vibration of the receiver plate correspondingly varied, the apparatus being thus capable of reproducing the pitch of the sounds.

In the early seventies, Alexander Graham Bell was working upon a harmonic telegraph, which, in its essential features comprises a permanent magnet opposite the pole of which were located a number of reeds each adapted to vibrate at a different rate. Encircling the magnet was a coil of wire connected with the coil of a similar instrument at a distance. When one of the reeds was set in vibration, it executed a definite number of vibrations, the number being peculiar to the reed, and the successive approach of its end to the end of the magnet varied the strength of the magnet, thus inducing in the coil a current which traversing the coil at the receiving station, varied the strength of the magnet which it encircled to cause the successive attraction of a reed having the same characteristic vibration. None of the reeds at the receiving station thus vibrate except those whose correspondents at the transmitter vibrate, and, if a number of the reeds at the transmitting station are caused to vibrate, the corresponding reeds at the receiving station are set in vibration.

Now, since complex sounds may be resolved into a number of superimposed simple sounds, Bell concluded that if the reeds be mounted flexibly enough to vibrate under the influence of sound waves, and are sufficient in number, a person in speaking against the reeds would set such reeds, the vibration of which when compounded produce the sound, into vibration, thus causing the corresponding reeds at the receiver to vibrate and reproduce the sound. From this conception of the production of all the simple tones of which the complex tone is composed, Bell taking a lesson from the human ear, advanced to the conception of a diaphragm which should have not a characteristic vibration to respond to a particular sound, but which should respond to all sounds and the development of this idea led to the production of the magnetic telephone.

Elisha Gray was at this time also working upon a harmonic telegraph, and independently conceived the requisite of speech transmission. His receiver embodied the principle of Bell's telephone, but for a transmitter he provided means for producing changes in the resistance of an electric circuit by the variable immersion in a body of mercury of a needle carried upon the diaphragm, the needle and the mercury being included in the circuit. It soon became evident that the electro dynamic or resistance varying telephone of Gray was the best for transmitting the sounds, and the improvements of Berliner, Edison and Blake soon followed.

The variations of current produced by solid electrodes is limited and the transmitter has been improved by Hunning by using granular carbon between a stationary plate and the vibrating diaphragm, a greater variation of resistance for a given movement of the diaphragm being thus secured. The Hunning transmitter, with improvements for preventing the caking of the granular material marks the highest stage of development of the telephone transmitter.

Thus we see that the development of the telephone has been a gradual one, each but adds his mite to the amassed knowledge of society the process continuing until some one happily supplies that last step. The steps when considered in the light of retrospect often seem small, indeed, yet they were all necessary to accomplish the completed journey. Thus, we see that Morse did little more than provide a key for Sturgeon's electromagnet. Reis did but little more than substitute for the manual key of Morse, one more sensitively constructed to be operated by the vocal organs. Bell did but little more than mount the plate of Reis as a diaphragm and conceive the idea of using it as a transmitting instrument to produce the all essential undulatory current and in fact all of the variable contact transmitters are but little more than the Reis transmitter properly adjusted. But we, standing at a distance, must not forget that the act is more difficult in the performance than in the after contemplation, and that all of those to whom we are indebted for the perfection of the telephone from Oersted to Hunning, merit our praise, for each has performed an indispensable part.

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*Abstract of paper read before Chicago Electrical Association, Jan. 23, 1894.

What I Don't Know About Electricity.—First Paper.

BY GEORGE CUTTER.

A discussion of electrical problems fairly well understood is always beneficial, because the different styles of description and the different analogies used tend to enlarge the comprehension of the subjects discussed. This is more emphatically the case when the problems of our loved science are treated in a plain, practical way, and the analogies used are the common mechanical phenomena so well understood by the great mass of students interested in solving the problems (theoretical and practical) of electricity.

"Electricity is in its infancy" is an expression that has been so often used in the last few years that it has become rather ancient, so we sometimes add that it is a "giant" baby. But the fact still remains that our science is very young, and in spite of its enormous growth in its applications in practical work it has not yet entered that stage which entitles it to the honor of beginning the age of electricity. It is still the age of steam and electricity is simply the most flexible and economical means of distributing steam power. For this reason, "what I don't know about electricity" is vastly more interesting than what I do know, and the pleasure of learning what our discoverers and vast thinkers are saying and doing is cast entirely in the shade by the great pleasure of "dreaming" over the great unknown in our science.

I don't know any greater pleasure than to sit in a lazy way in my easy chair before an open fire winter evenings or swinging in a hammock warm summer evenings and speculate on the developments of our science in the future and picture in my imagination the great changes which will occur in our lives when the age of steam has passed and the age of electricity has come. My greatest hope is to live long enough to see electricity produced by such means as to have it replace steam, and thus inaugurate the next cycle of our advancement: The age of electricity. In considering what I don't know about electricity, I do not intend to confine myself to the great unknown of the next cycle, but shall include subjects pertaining to our present application of the science.

For instance, "I don't know" how to make residence lighting profitable, in the great majority of our lighting plants of to-day. This is a problem now being considered by station managers and electrical engineers all over the country. There are many difficulties in the way of profitably lighting the residence portion of cities or towns. The consumers are so scattered that the investment in circuits is quite heavy for a rather light load. How are we to conclude as to the sizes of these circuits, and the amount of capital we can afford to invest in them. After deciding to reach out into a certain residence district, there appears to be no doubt but we should decide to use nothing but the best of material and build the most substantial lines possible in order to reduce the cost of maintenance to a minimum as otherwise the repairs and changes are almost certain to use up every cent of the small profit possible in this class of lighting. Then again, the poles, cross-arms, etc., should be so planned as to permit a considerable increase in our circuits without any further investment in circuit supports, because the difference in cost between a flimsy pole line only capable of carrying small circuits, and a substantial pole line capable of carrying the heavy circuits, sure to be demanded by the increase in domestic applications of our science is really a very small percentage on the total cost of the plant. There is some considerable force in the argument that we must not try to plan very far ahead as the developments of the future may so revolutionize our work as to render our apparatus and plant worthless. But in circuits for residence lighting this danger disappears and we can well afford to build pole lines that will stand for many years without much cost of repairs. The circuits can be planned as to only require the conductors for the present or immediate future, but should be so planned as to be easily reinforced without replacement, as the load increases.

The fact that residences only use (except on rare occasions) about 10 or 15 per cent. of the full complement of lamps is the greatest difficulty in the way of profitably lighting them. A house wired for 250 lamps may not use over 30 lamps at one time for several months. If an alternating plant is used this house requires transformer and meter capacity for 250 lights with only 30 in use. But in case of a banquet the whole 250 lights are required. Where it is possible to use one large tranformer for several residences the transformer investment can be very materially reduced as all these houses do not have banquets at the same time; we still have large meters to pay for, and we keep them working on a light load. I have thought that some stations taking on residence lighting could establish a maximum load to be allowed a residence without first notifying the lighting company. This company would then have a large transformer on a truck which would be connected to a residence whenever a demand was made for "brilliant illumination." This would enable the company to operate an average load of 30 lamps by a 30 lamp transformer and meter investment, and also give the electrician an opportunity to examine the local circuits and learn if they are in condition to carry the extra load.

It is embarrassing, and causes loss of patronage if the lights go out in the middle of a fine banquet, simply because something had happened to cut-outs, sockets, switches or circuits during their long idleness which renders them incapable of carrying the extra heavy load. The scheme adopted by the company at Whitewater, Wis., is also a very good system for the smaller residences, and if accompanied by some instrument to record the time the lights are burning in the residences affords quite a satisfactory method of lighting these small residences at a fixed charge per hour. The scheme is to place a specially designed switch in the central location, this switch limits the number of lamps in use, but enables the consumer to throw in any of the lights in the house up to the number contracted for, so that the house can be wired for 20 lamps, and the owner can use any four of the twenty; paying a fixed charge per month, if no time recorder be used, or a fixed price per hour when the time is measured.

Electric cooking and heating and the many uses to which small motors will be applied in the the household will very materially simplify the problem of earning money by supplying electricity to residences. "I don't know" why it is that more attention has not been given to domestic applications of the electric motor, washing, ironing, bread mixing, etc., can be so well done in this way and at small cost for current, and all such applications are so much needed at present to enable the central staions to run day circuits. These central station managers are hungry for means of loading up day circuits to a profitable point, and manufacturers and supply men should cook up as many schemes as possible for this purpose. There is certainly a good market ready.

Evidently I must leave thoughts of the great unknown future age of electricity for some later issue of INDUSTRIES, so will close this first article with the "I don't know" of another department of our business, viz., the telephone. How vast this subject grows as we consider it, but who knows how it is going to be handled. I wish a telephone in my house so my wife can communicate with the neighbors. I will feel much easier about her being left all day in our house with only the servants when I know she can call upon the neighbors in case of need. This is certainly possible now the monopoly is broken, and I look forward to the time when some system will be devised for using trunk lines from town to town in conjunction with the small village plants, so that the residence is at all times in communication with the rest of the country. The system is feasible and will come, but "I don't know" how much it is going to be retarded by trade jealousies and business competition. "You can't use my wire unless you have my telephone on my terms," may retard the great and universal benefit of the telephone which can otherwise be made possible. We would gladly put in telephones in our homes for local use without profit in the small local plant if we could arrange to use the lines to Chicago and the Chicago exchange. The tolls to be collected in this way will ultimately bring about such an arrangement irrespective of what make of 'phone is used in our little suburban settlement.

The Buckeye Lamp Case.

On January 23 the motion of the Buckeye Electric Co. to dissolve the injunction allowed against them in July, 1893, in the suit of the Edison Electric Light Co. for infringement of the Edison lamp patent, was granted by Judge Ricks in the circuit court of the United States, Northern District of Ohio. The opinion of the court is preceded by an elaborate statement of the case, in which the various points at issue are set forth.

OPINION OF THE COURT.

It will be seen from the foregoing statement of facts that the complainants do not deny the proceedings instituted by them in November, 1883, in the Patent Office, substantially as set forth in the defendant's motion. But they contend that they are not bound by the action of the Patent Office taken upon their petition, for several reasons; among these and chiefly:

First: Because the petition for a limitation upon the duration of their patent, filed by the complainants, and the proceedings in support thereof on their part, were taken under a mistake as to the law and as to their rights under the patent, and that this error was corrected as soon as possible after discovery.

Second: Because the action and orders of the Patent Office were without authority of law, of no force and validity, and therefore did not in any way affect the patent.

The court here reviews the causes to which was due the error or misunderstanding which led to the filing of the first petition, and also gives copies of the certificates of the Commissioner of Patents.

What is the legal effect of these applications of the petitioner, and the action of the Commissioner of Patents thereon? It is urged on behalf of the defendant that these proceedings, deliberately taken by the complainants, amounted to a voluntary dedication by them to the public of the patent, from and after November 10, 1893, at which time the British patent expired by limitation. It is contended in reply, that, even though such action was a dedication by the complainants as claimed, it was a dedication of something which was to be given to the public some time in the future, and long before the dedication was to take effect, it was revoked and annulled, and no rights thereby passed, either to the defendant or to the public.

Was this conduct and action of the complainants an abandonment of some right, or a dedication to the public of a privilege or right conferred? * * * It was a voluntary act by which they declared a limitation upon the duration of their patent, which shortened its term. * *

What, then, did the complainants intend to do, and what did they think they had the legal right to do with reference to the legal difficulties which they believed then surrounded them? There can be no doubt as to what their intentions and purposes then were. They asked for the right to limit their United States patent so that it might expire at the same time with the patent named having the shortest time to run. * Acting under such a belief of their legal relations to the public, they then fixed the limit for their patent for what seemed to them a pressing necessity and a sufficient consideration. Whether the Patent Office was authorized by law, or not, to make such official correction, the petitioners unquestionably had the legal power to voluntarily fix a limit upon the duration of their own patent. * * *

While it is true that the complainants' proceedings in the Patent Office were not had with any reference to the defendant, but had reference solely to their relations to the public, the defendants had, as one of the public, the same right to be influenced and governed by the complainants' conduct as though it had been the result of their representations to each other as individuals or corporations. The complainants' proceedings were a matter of public record. Their acts and conduct were of such notoriety that the defendant, by law, was bound to take notice of them so far as they affected its legal rights under the complainants' patent. * * *

Whatever may be the complainants' claim with reference to defendant's statement of the circumstances under which it originally entered into this enterprise, it seems well established by the affidavits of the defendant's directors that its capital stock was increased, and its capacity for manufacturing incandescent lamps greatly enlarged by reason of its belief that the complainants' patent, by its own conduct, was limited so as to expire on the tenth of November, 1893.

This was a very important fact, and the claim that it largely influenced the defendant in its conduct is both reasonable and natural. For the reasons hereinbefore fully considered, it seems to me plain that the complainant is estopped from now claiming that its conduct did not induce such well defined belief as to the limitation of its patent on the defendant's part. Without deciding how far others not similarly situated had the right to rely upon such conduct on the part of the complainants, or without passing upon the question of how far the public generally acquired rights under the complainants' proceedings in the Patent Office, by which they limited the life of their patent, it is sufficient to find, under this motion, that the defendant, by reason of the circumstances particularly set forth in its motion, did rely in good faith upon the complainants' conduct, and had a right to be, and was in fact, influenced thereby. * * *

As the case is now presented on the motion to dissolve, one of the two parties must suffer loss. If the injunction is continued, the defendant is wholly without remedy. It has shown that it was honestly misled by complainants' conduct, and in good faith made additional investments upon the belief so formed. The complainants cannot complain if, for this reason, the benefit of the doubts expressed are given to the defendant and the injunction is dissolved. If I am in error as to this conclusion, no great harm can result to the complainants, for if such error is established they can recover for the damages caused thereby, and their right to contest as to other infringers not able to show such meritorious claims to estoppel as defendant has established can be asserted without prejudice from this decision.

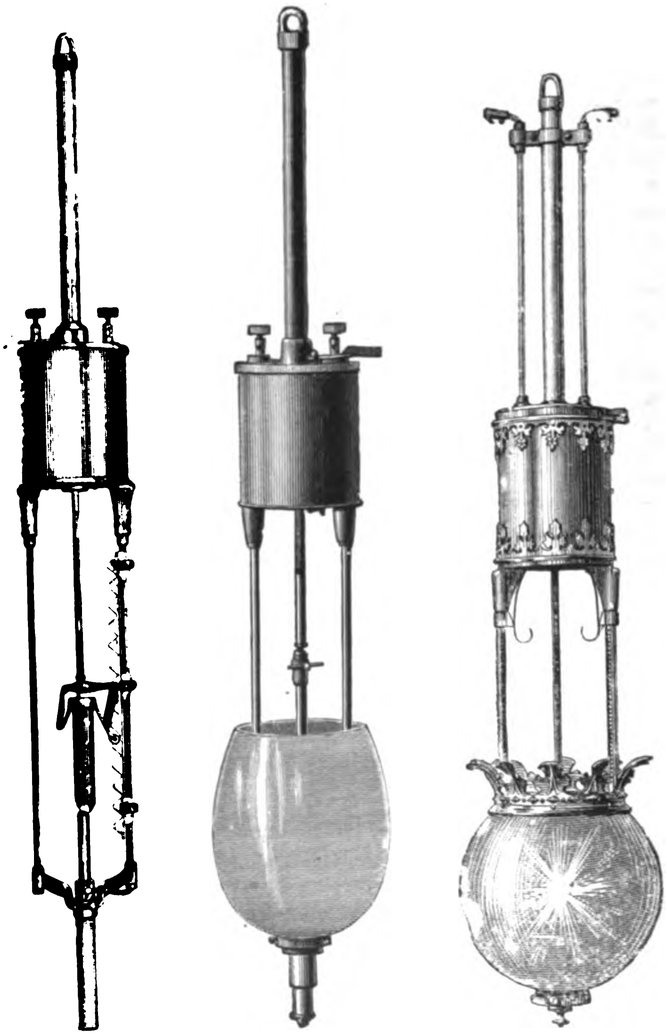
The Arc Lamp.

The Central Stations of the United States furnish current for over three hundred thousand arc lights, yet it is but fifteen years since the first practical arc lamp was placed on the market. This remarkable growth forms a most important part of recent history which is noteworthy for commercial and industrial advancement. So superior was the arc light to other forms of lighting that its adoption was immediate and general. Active minds perfected the details of the system, and capital and energy placed it on the market. Cities and towns were equipped until there is now scarcely a hamlet but what has its central station. The old towns in the east welcomed it. The new towns in the west demanded it. The boom town gave a bonus to the capitalist that would provide it with a station and the arc light soon shed its rays over the prairie or among the trees which were scattered over the hills of the northwest. It lighted the streets that were formerly marked at night by the row of flickering, smoking oil or gas lamps and permitted the citizen to go forth at night as confident of his safety as during the day. The capital now invested and the number of persons engaged in the industry places it prominently among the great industries of the country.

For street lighting, illuminating large areas or for places where a light of a character approaching that of sun light is required the arc light is unrivalled. It is more efficient and economical than other forms of electric lighting. Its position in this respect is established and it is improbable that it will be changed although in view of past discoveries it is not impossible. Experience has shown the method of securing the best results and in line construction and manner of distributing and hanging lamps radical improvements have been made since the first installation. The tower system strongly advocated at one time has been abandoned and the lights distributed nearer the ground, the distance apart and method of suspension being determined by the location and capital to be expended. One of the neatest designed posts for street and boulevard lighting has been adopted by the city of Chicago. When placed along the boulevards the light is thrown out over the roadway and across the central lawn. The single supporting arm casts but a light shadow across the walk. As used in Chicago the wires are run from the underground system within the posts, and the posts are thus unencumbered. For suspending the lamps over the center of the street intersections a number of devices are successfully used in cities and towns which permit the lamp to be lowered for trimming.

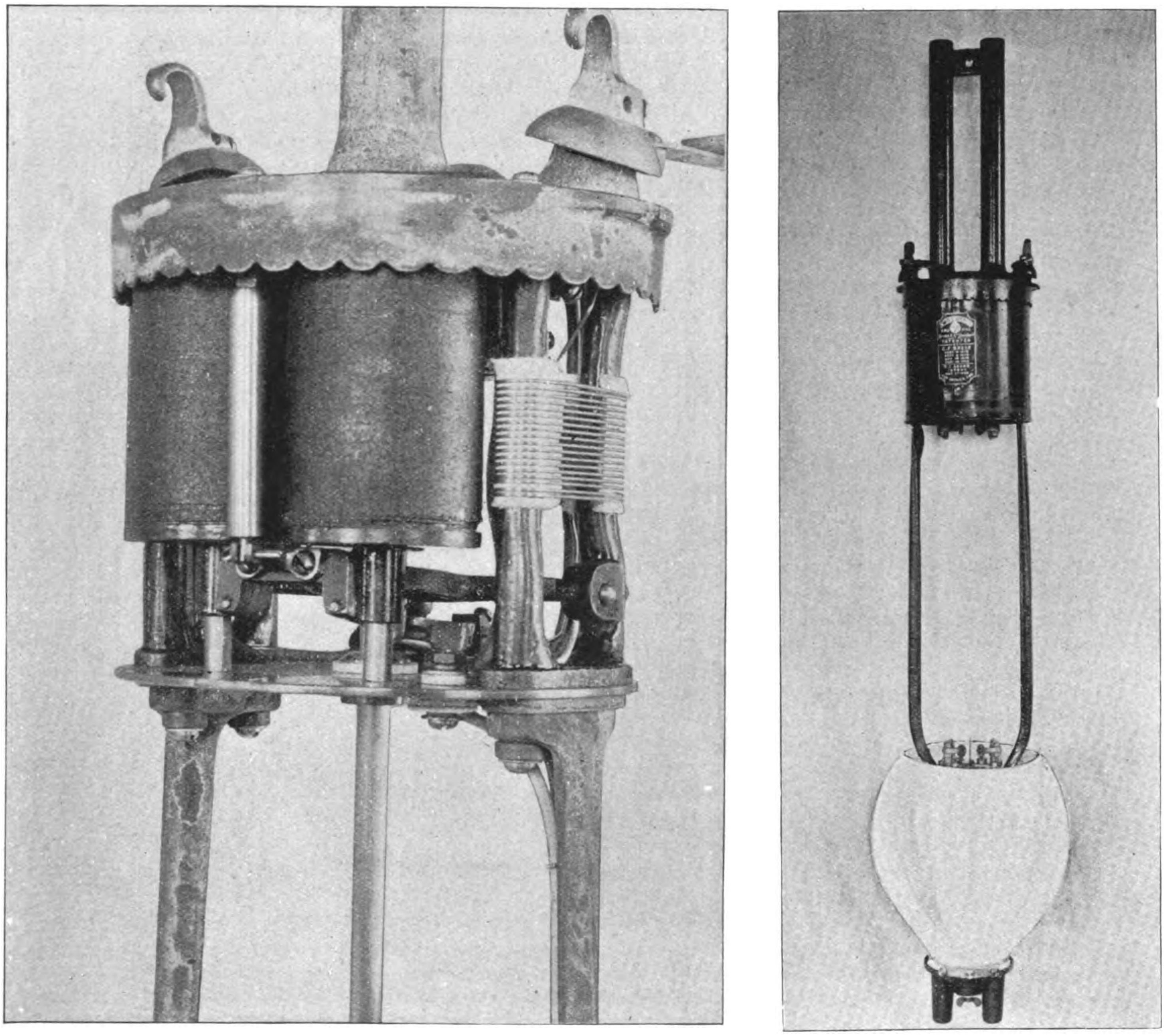
The arc lamp now manufactured differs but little in general appearance from those first in use. The changes have been made mostly in perfecting the mechanical details of the lamp. Some sharp digressions have been made in one or two instances, but the lamp of ten years ago is very much like the lamp of to-day. However, changes have been made in its construction and mounting to adapt it to the alternating current, for use on multiple or incandescent circuits, for theatre lighting, as a projector or for the use of the photo-engraver. A sufficient demand has arisen in these directions to warrant the equipment of factories for their exclusive manufacture. The electric arc is also used for a number of special purposes and we shall undoubtedly see it put to many others. A considerable interest was taken toward the close of the Columbian Exposition in the cloud projector displayed there, and an optical lantern has been placed on the market in which an arc light takes the place of the calcium light.

An effort was made to burn incandescent lights on series circuits with arc lamps but was abandoned on account of the complication of the system. The arc lamps on the incandescent circuits are successfully used. For interior arc lighting the art of the designer and decorator is apparent in the many designs of ornamental arc lamps. Special attention has been given to this branch of arc lighting by several companies, and the lamps now on the market are sufficiently ornamental to suit the taste of the most fastidious. There are at the present time eighteen companies in the United States actively engaged in the manufacture of arc lamps. Some of them helped to introduce the system of arc lighting, while others have but recently placed their lamps on the market. In this article we will endeavor to place before our readers a sketch of the different arc lamps.



FIGS. 1 3.—THE ARC LAMP.—BALL ARC LAMPS.

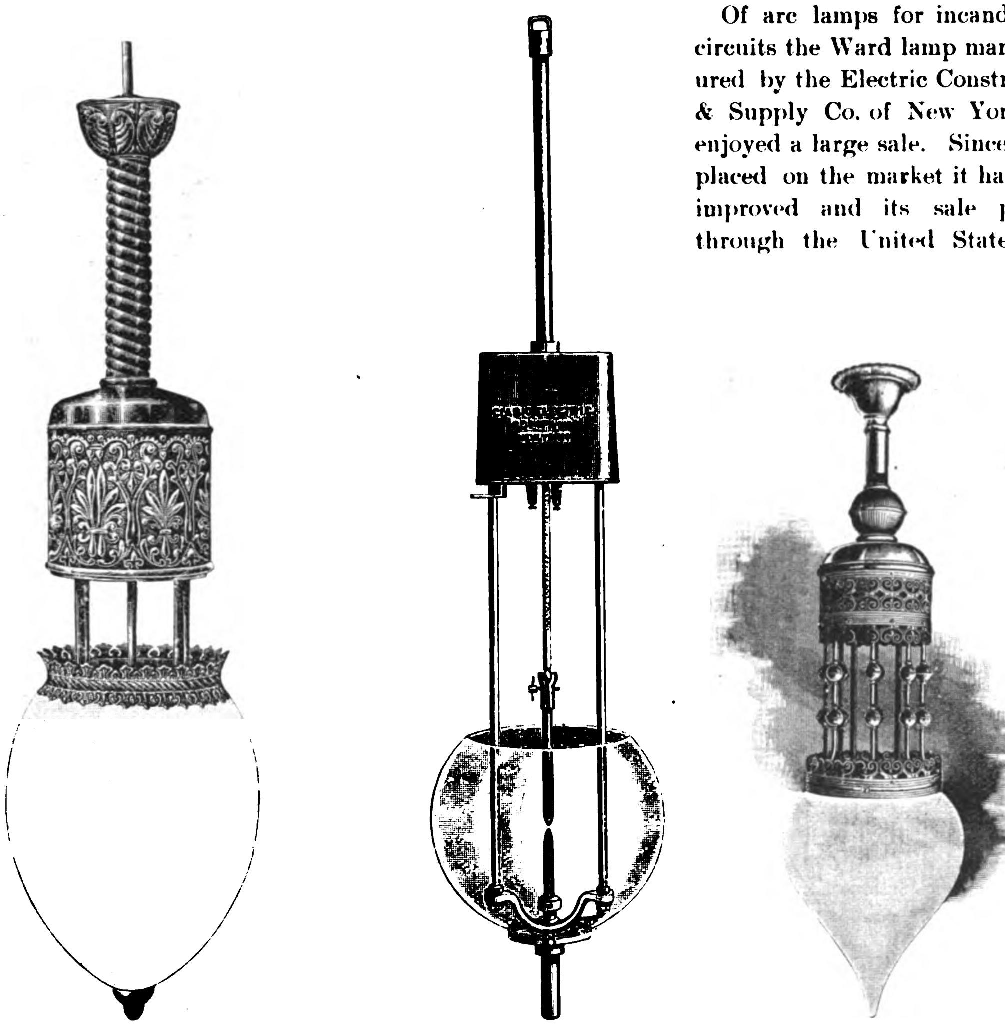
Among the earlier systems of arc lighting was one invented by Chas. E. Ball, a mechanical engineer. For the manufacture and sale of the apparatus the Ball Electric Mfg. Co. was organized which was succeeded in 1886 by the Ball Electric Light Co. This company, from its headquarters at 404 W. 27th St. is pushing the sale of its apparatus throughout the United States, Mexico, Central and South America. The years of experience since the Ball lamp was placed on the market has shown the good qualities of the lamp and corrected whatever imperfections it may have had. The regulation of the lamp is effected by electro-magnets in the line and shunt circuits, no springs or clutches are used. It can be adjusted to burn on either arc or incandescent circuits. The 800 candle power lamp manufactured by the company has been found most economical for places where the full light of the 2,000 candle power lamp is not required. It is operated in a similar manner to the regular lamp. The company has given considerable attention to the appearance of its lamps and furnishes them plain or ornamented as handsomely as desired. Figs. 1 and 2 show the lamp plain and ornamented. The lamps are steady and noiseless in operation.



FIGS. 4, 5.—THE ARC LAMP.—LAMPS OF THE BRUSH ELECTRIC CO.

With the Brush arc lamp every central station man is familiar. The name Brush is as closely associated with the arc lamp as the name Edison is with the incandescent. The Brush-Adams lamp, the latest improved lamp placed on the market by the Brush company, differs greatly from the lamp brought out in 1879 by Chas. F. Brush, yet the fundamental principles are the same. In the lamps first made a spring was used to adjust the length of the arc but it was considered advisable by the makers to dispense with all springs in the lamps and in this lamp no springs are employed. The solenoid form of main spools have been replaced by electro-magnets giving a better magnetic circuit and greater strength and the friction of the different moving parts of the lamp becomes a smaller factor. The arrangement of the mechanism of the lamp is shown in the accompanying cuts. Formerly the carbon rod was allowed to slip gradually through the clamp but this method was found in practice to be objectionable on account of the rod becoming dirty and thus clinging to the clamp. In the new lamp the rod is entirely released and the amount of dirt that may collect on the carbon rod has no effect on the feeding of the carbon. The clamp grips the rod, lowers it and when it reaches a certain point it entirely releases the rod and takes a hold higher up. As the carbons come together the action of the electro-magnets draws them apart until they reach the proper distance where they would remain were it not for the consumption of the carbon which increases the distance between the carbon points and consequently the resistance of the arc. The magnets lose their influence over their armatures when the resistance of the arc reaches a certain point and the carbon drops when it is instantly drawn up to the proper distance as before. The positive action and strength of each part are conducive to a perfect light and the durability of the lamp. The arc is so quickly established that the waver of the arc is scarcely noticeable. An important feature of the lamp is the absence of solder in ts make up. The entire lamp may be taken apart and assembled by the use of a screw driver alone. The cut-out faces are vertical so that there is no liability of dust gathering and injuring the contact. The parts of all lamps are made interchangable. The carbon holders are adjustable to from $\frac{7}{16}$ to $\frac{3}{8}$ carbons. In Fig. 0 a new method of dropping the globe for trimming is shown. The company manufactures an extensive line of arc lamps adapted to a variety of places.

The Clark Electric Co. of New York through recent patents for an alternating current arc lamp now has a complete line of arc lamps on the market. This new alternating current lamp has been in use for a year and has given perfect satisfaction to the numerous persons now using them. The Clark arc lamp has long been known for its steadiness and reliability. The fact that Clark lamps have been burned twenty-three thousand hours without repair is sufficient evidence of their durability. The company has been well managed and the purposes of the company of placing the best possible apparatus in the hands of their customers has worked to its advantage. The engineers have shown skill in the design of the lamps. Symmetrical outlines with neatly designed fittings and trimmings give the lamp an ornamental appearance. The alternating current lamp shown in the accompanying cut illustrates one of the neat patterns in which the lamp is made. Other styles even more elaborate in design are constructed of the regular series arc light. The business of the company is under the direction of Mr. James H. Seymour, the president of the company.



FIGS. 6–8.—THE ARC LAMP.—THE CLARK A C, D C AND ORNAMENTAL LAMP.

The Eureka Electric Co. of New York control the arc lamps and systems of lighting, invented by Mr. Osborn P. Loomis. The lamps which are designed for incandescent circuits have been on the market about three years and were brought out to meet the demand for arc lights in connection with incandescent service. With the extension of incandescent lighting and the installation of large numbers of isolated plants, a few arc lights were found more serviceable in many places than a cluster of incandescents. This was found especially true in factories and where outdoor lights were desired. The practical use of the Loomis lamp since it was placed on the market has shown its value for illumination. The lamp mechanism is simple in construction, the carbon rod being operated by a clutch controlled by electromagnets, the movement of which is modified slightly by a dash pot, thus securing a steady light. The sale of these lamps has not been pushed to any great extent and their sale has been largest in the east.

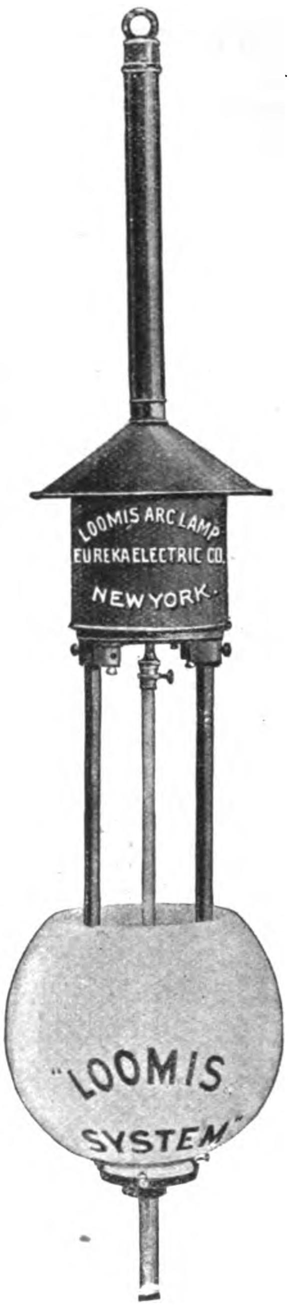
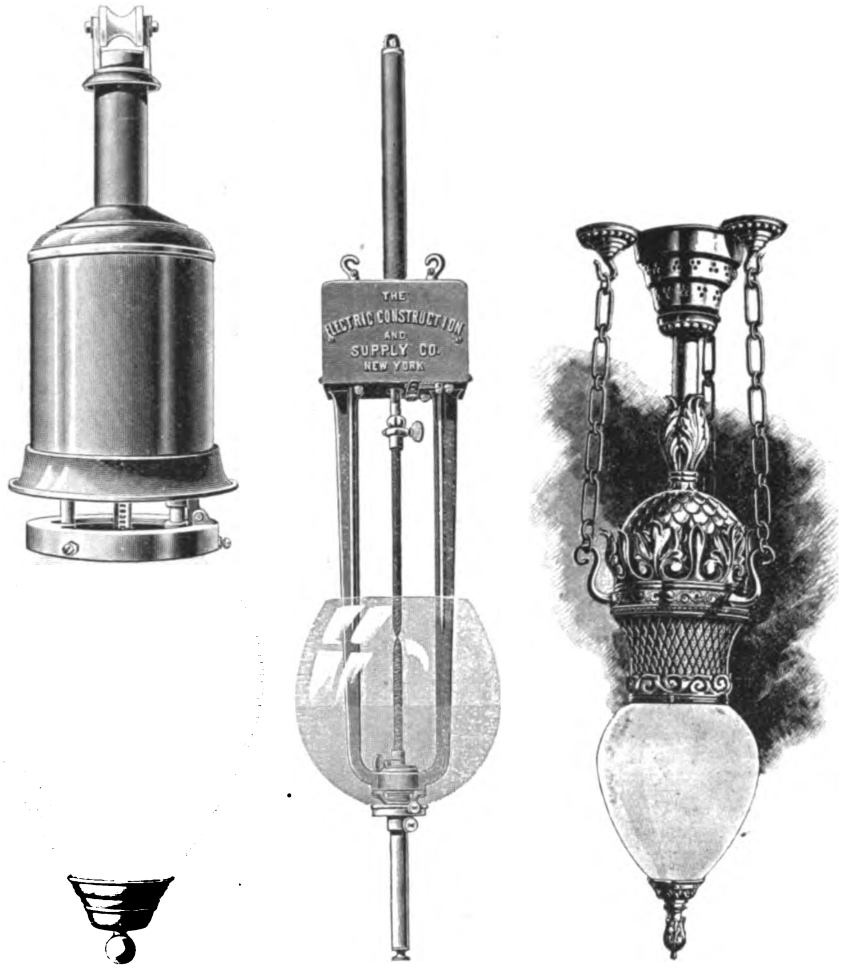
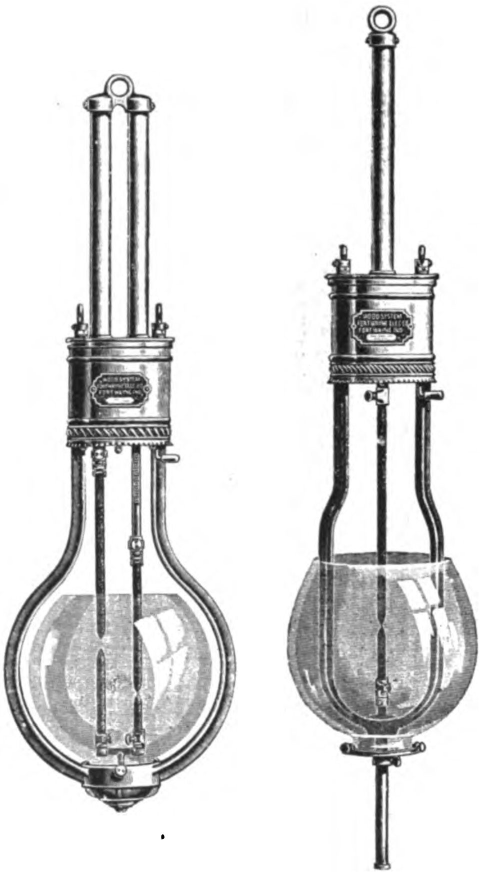

LOOMIS ARC LAMP
EUREKA ELECTRIC CO.
NEW YORK.
"LOOMIS SYSTEM"

FIG. 9.—LOOMIS ARC LAMP.

Of arc lamps for incandescent circuits the Ward lamp manufactured by the Electric Construction & Supply Co. of New York, has enjoyed a large sale. Since it was placed on the market it has been improved and its sale pushed through the United States and neighboring markets. It made its appearance about the time electric light stations became convinced that incandescent lamps could not be used on series arc circuits with any degree of success.

The Ward lamp seemed to supply the means of securing both kinds of light from the same circuit and was sold in large numbers. Its manufacturers have increased the line of lamps by the addition of an alternating current lamp which has recently made its appearance and also by a line of arc lamps for special purposes including a lamp for the photo-engraver, a focusing lamp for theaters, search lights, steoreopticon and the ophthalmoscope. The lamp for incandescent circuits is modified in a number of ways to adapt it for the numerous places in which it is used. For an all night lamp or where a lamp is desired that will burn a long time without trimming, a double lamp is made with two pairs of carbons. For low ceilings a short lamp is made with either single or double carbons. This style is not only used to advantage in buildings having low ceilings, but for a tunnel lamp it is also found desirable. The ordinary arc lamp is not a very ornamental object but skill in the design of the globe and the casings for the various parts has done much to make it attractive. The Ward ornamental lamps show a variety of designs which would grace any place where an arc lamp might be used. The highly polished and ornamented brass trimmings wrought into shapes that entirely conceal the working parts of the lamp, are seen only as a bright reflection above the light of the arc, and when the lamp is not in use form a neat ornament. Another design of Ward lamp is that used on street railway circuits. They are run ten in series and each lamp is fitted with a compensating resistance equal to the resistance of the lamp which is thrown into circuit when for any cause the lamp does not burn. The new alternating current arc lamp is designed for a 30 volt secondary on which it needs no resistance. On the 50 volt secondary it is necessary to interpose a resistance. The mechanism of the lamp is simple with few parts, they are enclosed in a weatherproof box and no hood is required when used out doors. The device for holding the globe has received special attention in the perfection of the lamp and the device for attaching and holding the globe in place greatly facilitates the trimming of the lamps and the cleaning of the globes.





FIGS. 10-12.—THE ARC LAMP.—WARD A. C., D. C. AND ORNAMENTAL LAMPS. FIGS. 13-14.—WOOD LAMPS.

The arc lighting apparatus of the Ft. Wayne Electric Co. has been long and favorably known to the trade. Many radical changes and improvements have recently been made in the apparatus. The arc lamps, the invention of Mr. James J. Wood, have been remodeled and possess many new features as placed on the market this year. They are constructed with either the gear or clutch feeding mechanism and of any candle power desired. The designs are very neat and the different styles of lamps manufactured are well adapted for the different places in which they are used. To meet the requirements of a longer or shorter time lamp single carbon, single carbon double service and double carbon lamps are manufactured. Both the regular and short lamps are made in these styles. Hand cut-outs, automatic cut-outs and an automatic short circuiting device that cuts the carbons entirely out of circuit when consumed, are fitted to each lamp. The ash cups facilitate cleaning and prevent the carbons dropping from the holders should the lamps be carelessly trimmed. The frame and casing of the lamps is weatherproof and is perfectly insulated from the circuit. The binding posts are fitted with hooks so that the lamp may be suspended from the hanger board in addition to the ring in the top of the frame. These lamps are used also on constant potential incandescent and alternating current circuits. All the devices necessary for their operation on these circuits are placed either in the hanger-board or in the lamp itself, and require no additional wiring on that account. The substantial construction of the lamps together with the close regulation of the feeding mechanism makes a durable and efficient lamp.

To suit the different conditions the arc light is required to fill the Excelsior Electric Co. New York manufacturers a number of styles of arc lamps. For street lighting, for interiors with high or low ceilings, for photographic purposes. for focusing light or search light the company has lamps especially adapted. The double carbon lamp for street lighting shown in the accompanying cut is an efficient all night lamp. The lamp has two sets of feeding mechanisms which are entirely separate. When one set of carbons is burned out a button on the end of the carbon rod trips a lever that releases the carbon rod of the second pair of carbons which are then thrown into circuit. The lamp is durably constructed and its method of operating very simple. When the current is not on the carbon points are a slight distance apart. The current being turned on the coarse coil of the bell shaped magnet draws down the lid armature to which the rod clutches are attached and allows the carbon rod to descend. As soon as the points come together the circuit of the upper magnet spool is closed, the coarse winding of the spool being in circuit with the carbons. This causes the armature to raise, opening the circuit of the coarse coil of the lower magnet and placing the carbon rod under the control of the fine winding of the lower magnet, by which the length of the arc is adjusted. The accompanying cut will illustrate the windings and connections of the lamp. This regulation is effected very smoothly, and the wavering of the light reduced to a minimum. The cut-out throws the lamp entirely out of circuit so that there is no danger to the trimmer. For hanging the lamp an inverted cast iron hood is provided. It is fitted with a slate base having terminals, cut-out, switch, etc. The operation of the lamp is highly satisfacfactory, as attested by the numerous stations at which they are used.

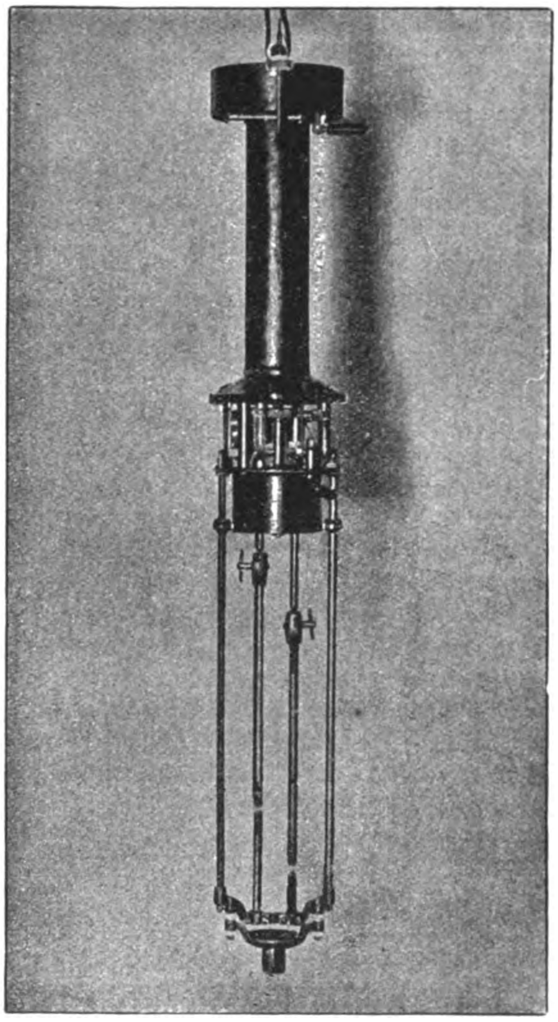


FIG. 15.—THE ARC LAMP.—EXCELSIOR.

The General Incandescent Arc Light Co. makes a specialty of arc lamps for incandescent circuits and has given particular attention to the construction of ornamental arc lamps. Having secured a lamp that was durably and efficiently constructed the company has ingeniously adapted its mountings to fill to advantage the many places in which the arc lamp had been used and by means of handsome fittings devised a lamp which found its way into many places from which the arc lamp had previously been barred. The line of lamps now manufactured include everything that modern requirements can use. The arc lamp had been little used for lighting interiors except those of factories and such as the element of ornamentation did not enter. The rough features of the lamp have been concealed within the ornamental designs, the necessary resistance for the circuit on which it is used is placed within the covering and the neatly finished lamp, varying in design to adapt it for entrances for the hotel lobby or dining room, for public halls or buildings, and many other places, has greatly extended the use of the arc lamp. Any candle power or amperage is furnished, but the regular stock sizes, 4, 6, 8 and 10 ampere, will meet most requirements.

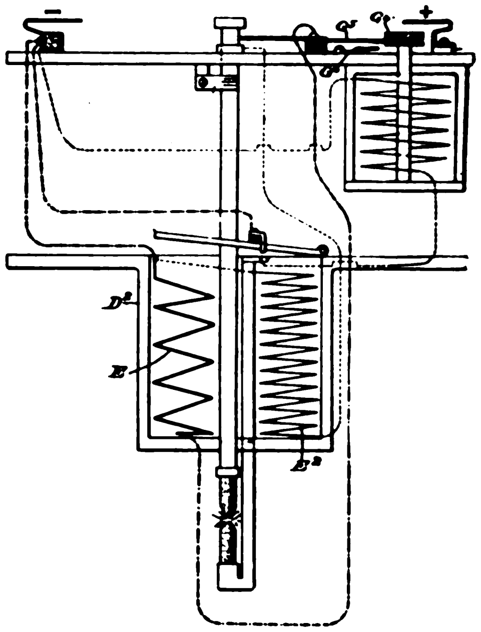
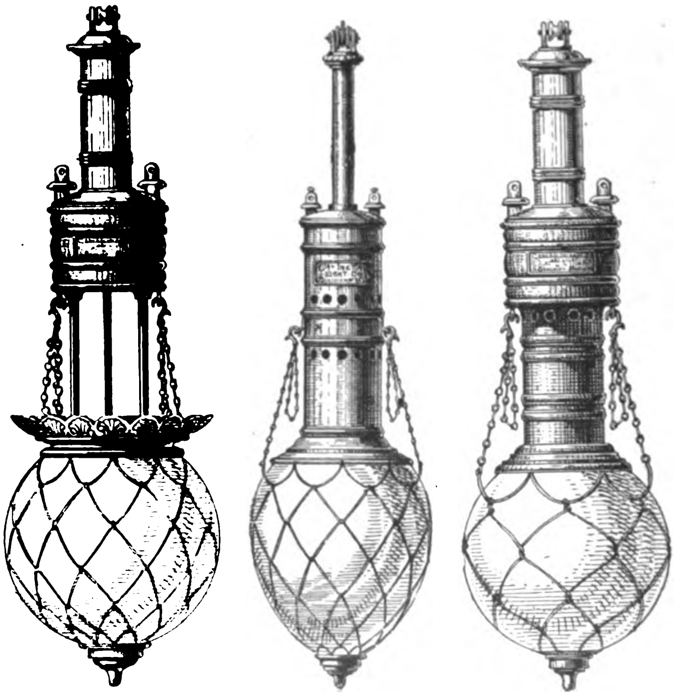
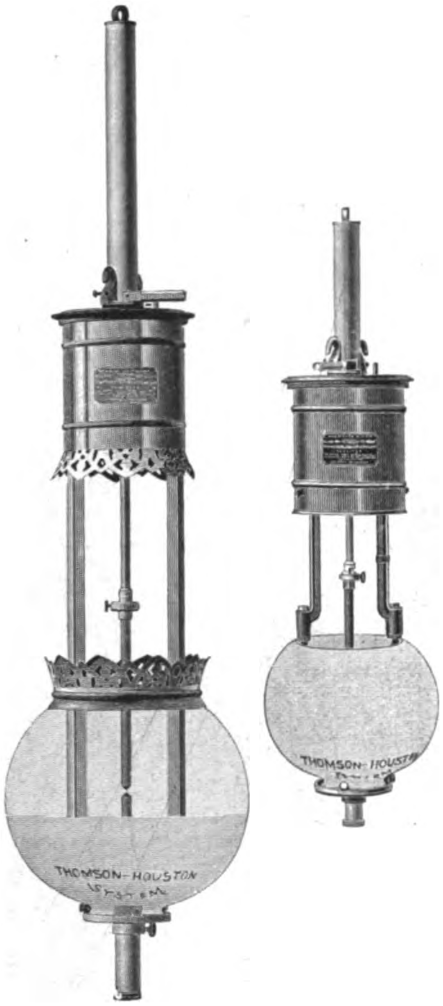


FIG. 16.—THE ARC LAMP.—EXCELSIOR.


FIGS. 17-19.—THE ARC LAMP.—GENERAL INCANDESCENT ARC LIGHT CO'S D. C., A. C. AND WEATHERPROOF LAMP.

The arc lamps now manufactured by the General Electric Company are manufactured under the Thomson-Rice patents. The sizes range between 1,200 and 4,000 candle power. Both the rod and ribbon feed mechanism are used and long, short and double lamps are made. The style of lamp is varied to adapt it to different conditions of service. The tunnel lamp, made with broad and very substantial frame, has been extensively used. The strong construction of the lamp makes it a durable lamp for places where the lamp is frequently handled. In many cases where the low ceiling prevents the use of the regular lamp, a short lamp can be used to advantage; for such places either the short clutch lamp or the ribbon feed lamp is well adapted. The double lamp burning a sufficient time where an all night light is desired. These lamps are made both plain and ornamented.

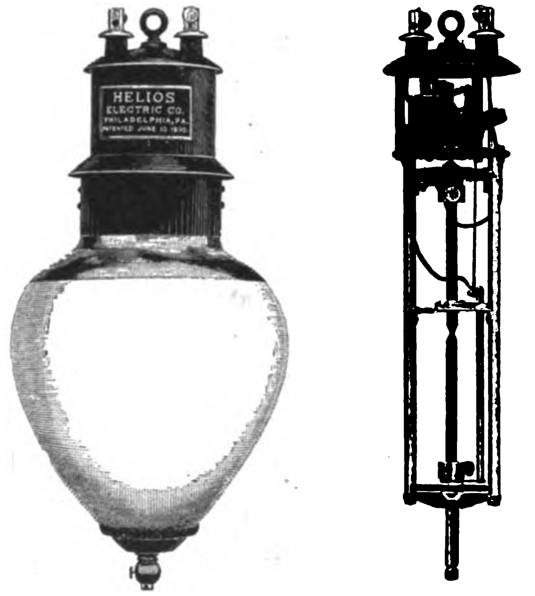


FIGS. 20-21.—THE GENERAL ELECTRIC ARC LAMP. FIG. 22.—THE GRAVES LAMP.

The ribbon feed lamps is adapted for either incandescent or series circuits and is particularly designed for indoor lighting. The arc is well regulated and a steady light is given. The General company has given a great deal of attention to the manufacture of search lights or projectors and has equipped a number of the U. S. war vessels with large projectors and lighting system. Several mountain summer resorts and river and lake steamers have also been furnished with search lights and the necessary equipments. Another form of arc lamp involving special construction is the arc light for electric fountains. In this direction the company has made great advancement and has manufactured a number of equipments for this interesting purpose.

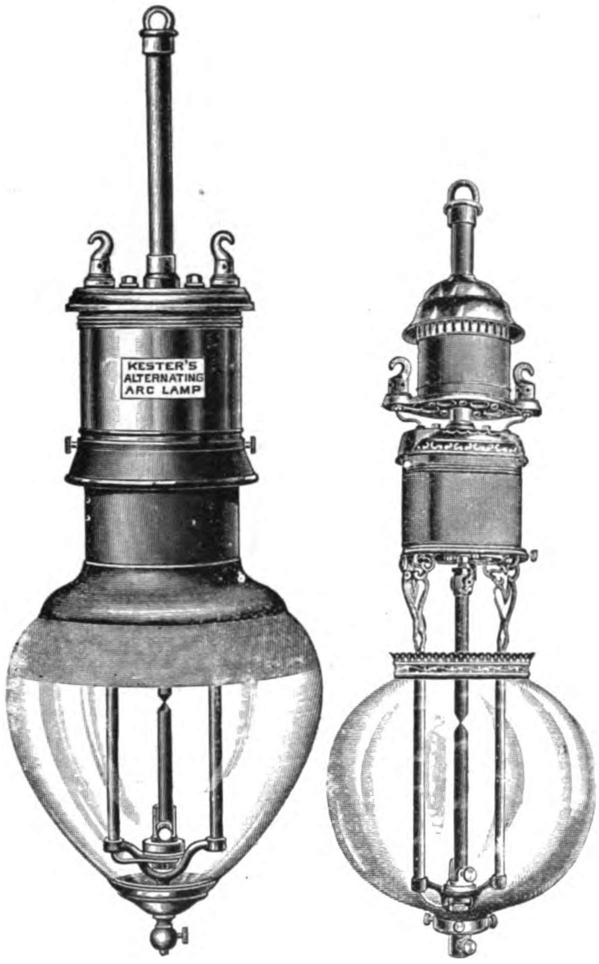
The accompanying cut shows the Graves arc lamp as now manufactured by the W. D. Graves Electrical and Machine Works, Cleveland, Ohio. This lamp has recently become prominent through the honors received at the World's Fair. The award given this lamp was not on minor details, but was "for good construction and satisfactory performance in use." This award is certainly a very broad one. This lamp contains no clock-work and no complicated mechanism to get out of order. The reliability and low cost of maintenance commends this lamp to all users of arc apparatus. Mr. Graves has recently purchased the entire plant of the W. D. Graves Electrical and Manufacturing Co., together with all its valuable patents, rights and franchises, and since added thereto other special tools and machinery to increase its facilities to meet the increased demand for arc lamps.

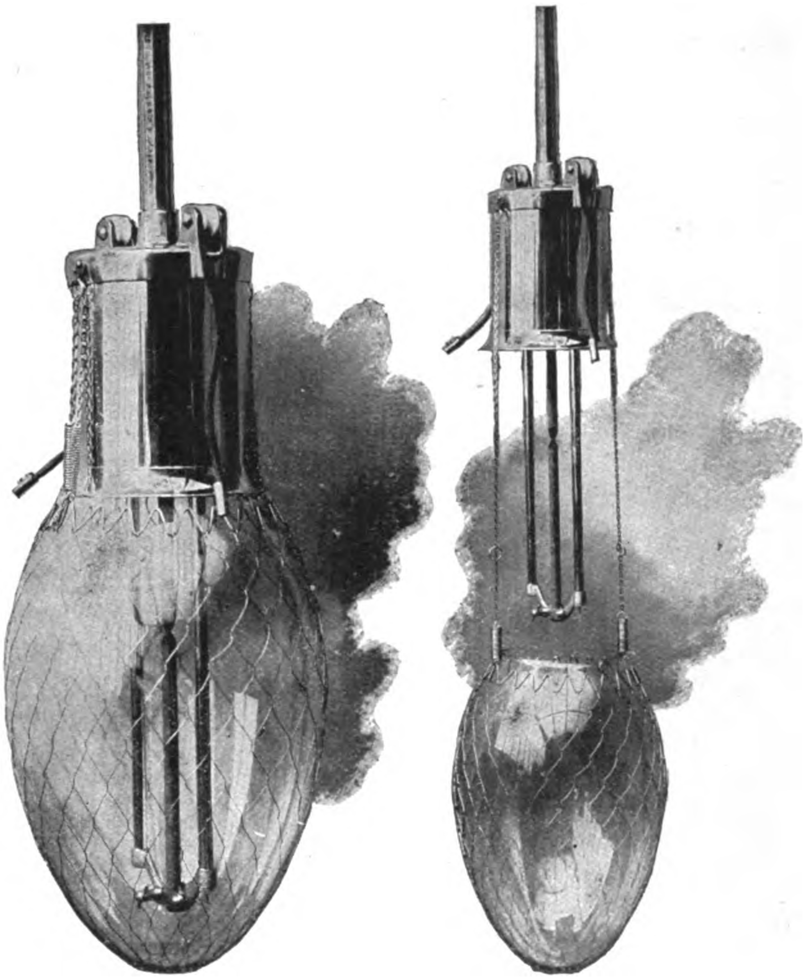
About a year ago the Helios arc lamp was placed on the American market. Its close regulation and excellent light immediately attracted attention. The feature of the lamp by which the arc was kept at the same point just below the reflector gave a most efficient distribution of the light. With the alternating current the two carbons are consumed an equal amount and the upper carbon being lowered and the lower one being raised the same amount, the arc is kept at approximately the same point. The regulation is effected entirely by a single solenoid coil. The feed of the carbons being controlled by a lever pressing against the periphery of a wheel included in the releasing train, a very fine and delicate feed is secured. There is a slight difference in the weight of the two carbon holders, the upper one being a trifle the heavier. The result is the work of the solenoid coil and mechanism is restricted simply to the small weight representing the difference between the carbon holders. A free piston dash serves to steady the movement of the regulating mechanism. The lamp is adapted for a low tension and may be run two in series. The Helios Electric Co. furnished several hundred of these lamps for the World's Fair.


HELIOS
ELECTRIC CO.
PHILADELPHIA, PA.

FIGS. 23-24.—THE ARC LAMP—HELIOS.

Another line of arc lamp that is coming to the front is the Kester arc lamps, manufactured and sold by the F. P. Little Electrical Construction and Supply Co., of Buffalo, N. Y. Arc lamps for all systems are now manufactured, the latest lamp brought out being the new alternating current lamp. The Kester lamps are all noticeable on account of their neat outlines and evident durability. The regulating mechanism is exceedingly simple and effects a close adjustment of the arc. The general style of the lamps is shown in the accompanying illustrations. The alternating current arc lamp shown is worthy of notice. The frame, rod, shell and cap are of brass, heavily laquered, making them easy to keep clean. While the lamp is entirely enclosed, every part is easily accessible for trimming or inspection. Trimming is quickly accomplished both on account of the method of opening the lamp but also on account of the style of carbon holders which grip the carbon firmly in the right position. The regular series arc lamp has not until comparatively recently been actively pushed in the trade, but the facilities of the company together with the full line of lamps now offered places it prominently in the field where its merits should bring it large sales. The improved Kester arc lamp for incandescent circuits has all the valuable features of the series arc lamp and is modified only sufficiently to adapt it to the incandescent circuit. The mechanical design of the different lamps, although in some lamps certain parts are slightly ornamented to vary the monotony is such as to be pleasing to the eye and requires no additional ornamentation to make them a suitable part of the furnishings of almost any place. The detail of the construction of the lamp have received special attention and all parts are made from standard designs. The parts are thus interchangable and repairs are easily made.


FIGS. 25–26.—THE ARC LAMP.—KESTER ALTERNATING AND DIRECT CURRENT.


FIGS. 27–28.—THE MOSHER A. C. LAMP.

In the accompanying cut is shown the new Mosher A C arc with globe in place, and also lowered for trimming showing the method of suspending the globe. The lamps are now being manufactured and will be ready for delivery the first of March. The lamp is designed for the 30 volt secondaries of alternating current circuits. A very simple method of regulating the arc has been devised without the use of magnets. The mechanism together with the other features of the lamp that have been solidly constructed make up a lamp which will be very durable, and it is said that the cost of repairs will not exceed one per cent. The enclosure of the arc subdues the slight noise produced by the alternating arc, and as there is nothing about the lamp that will become loose the lamp is practically noiseless. The lamp when trimmed with five-eighths by nine inch carbons running on 30 volt circuit with 14 amperes will burn 20 hours with one trimming as shown by experiments. The results given would be therefore as economical as could be desired. The lamp when adjusted for 30 volts will regulate itself between 25 and 35 volts should such a change occur in the circuit.

The electric arc has been little changed except as improved carbons have changed it since its introduction. An important step has, however, been taken in that direction, although sufficient time has not elapsed for a long test, and the reports from the stations where it is now being used will be watched with interest. The Royal Arc Electric Company of New York has put upon the market a device patented by Mr. L. E. Howard, which can be attached to any arc lamp, the object being to increase the life of the electrodes, and give a very steady light. Careful tests of arc lamps provided with this appurtenance were made in the laboratory of Cornell University and the results published in a paper on "A New Incandescent Arc Light,"[*] read before the International Electric Congress, at Chicago, by L. B. Marks, M.M.E., last August. As shown in the cuts, the device consists essentially of a small envelope of refractory glass in which the arc is enclosed. The envelope, or bulb, is provided with an air tight metal fitting at the bottom by which it may be fastened into the lower carbon holder. At the other end of bulb is a metal plug having an opening in it just large enough to admit of the feed of the upper electrode. A fireproof thimble of asbestos-pulp insulates the metal from the glass. A valve, shown in the cut, allows the egress of gas, but prevents the ingress of the air. In the new incandescent arc, the disagreeable flaming and hissing features are overcome. The arc plays in carbon gas, and the oxygen is prevented from attacking the electrodes. There is practically no combustion, as in the ordinary arc, but simply disintegration. The life of the electrodes is increased tenfold—under some conditions in a much greater proportion. There is no soot, all the products of disintegration being volatilized. Naturally, there is no flaming, for there is no oxygen to support combustion. As the presence of a carbon gas allows of almost twice the ordinary length of arc for the same potential difference, there is no liability to hiss. In fact, the conditions are such as to insure steadiness. When the lamp is in operation, the entire bulb appears to be luminous. An additional feature of interest in connection with this incandescent arc, and one which follows naturally from the fact that all the products of disintegration are consumed, is the entire suppression of sparks from the arc. The bulb is a perfect spark arrester. Many of these appurtenances are now in successful operation in this country. The first plant to adopt the system on all of its circuits was the Hartford Electric Light Company of Hartford, Conn.

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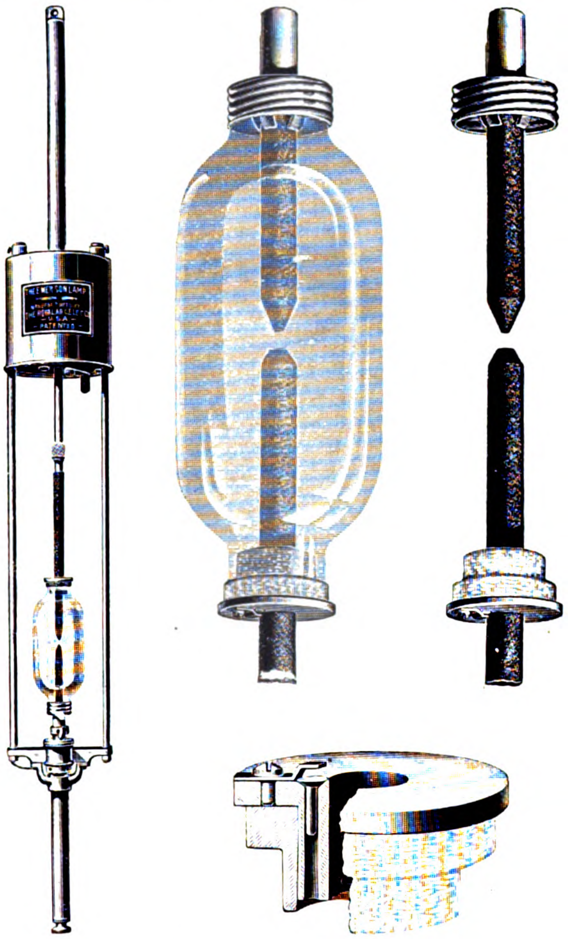
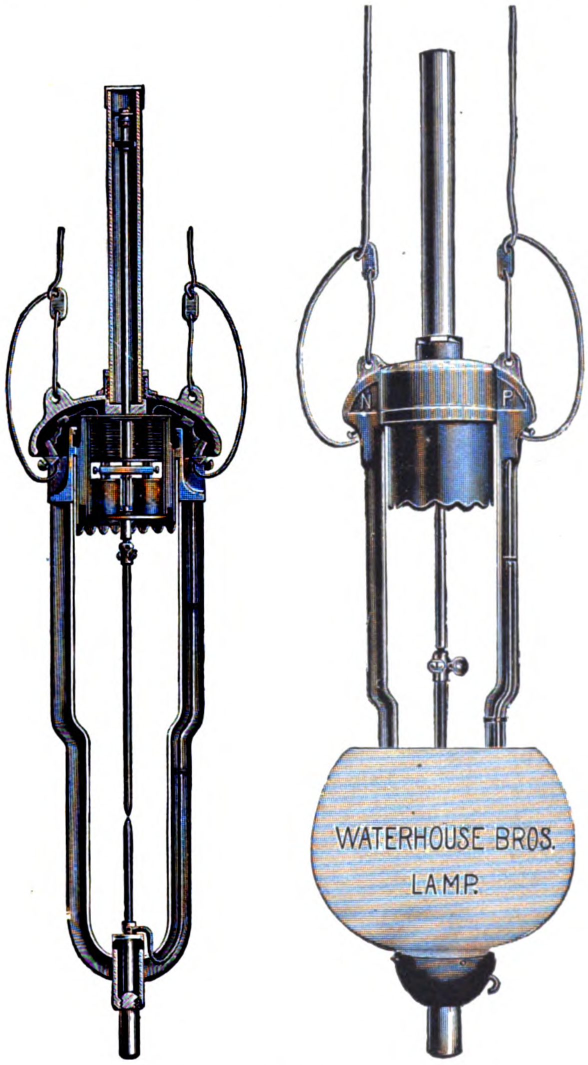
[*] Electrical Industries, Vol. IV, No 10, October 1893.


FIGS. 29–31.—THE ARC LAMP—ROYAL.

The Waterhouse lamp, manufactured by Waterhouse, Gamble & Co., of Hartford, Conn., and controlled in the west by George Cutter, is designed for incandescent circuits. It is placed two in series on incandescent circuits and the phrase "two in series never see saw," has become closely associated with the Waterhouse lamp. As will be noticed from the accompanying cuts of the interior of the lamp, the controlling machanism is small and well constructed. The ideas of the designer seem to have been well carried out in the perfect insulation and great durability of the lamp. It is dust and rain proof, and is con sequently unaffected by the weather. No hood or other encumbering device is needed in outdoor use. The part through which the connections for the lamp pass is composed of solid cement which prevents the rust or corrosion of the wires and connection and is also proof against the entrance of any foreign matter that might interfere with the perfect operation of the lamp. No insulating discs are needed since with the use of this cement it is unnecessary. The device for feeding the carbon and regulating the arc is of durable construction, the magnets being mounted in a cage cast in a single piece to insure perfect alignment. The magnets are mounted one set above the other and their armatures move in an exactly vertical line. The operation of the controlling device is thus free from all side friction and great sensitiveness is secured. Vibration of the upper carbon is prevented by a special form of dash pot. The globe holder is of a new design possessing several new features. The resistance used with the lamps is furnished either in a wall box or in a cage to be suspended above the lamp.



FIGS. 32–33.—THE WATERHOUSE ARC LAMP.

The Siemens & Halske Electric Co., of America, manufacturers a lamp adapted for series arc, constant potential or alternating current circuits. Although introduced but comparatively recently in the American market it cannot be classed as a new lamp having been largely used for many years in Europe. It has already reached a large enough sale so that many of our readers are familiar with its construction and method of operation. But to those who are not familiar with the lamp the following description of its construction may not be uninteresting. It belongs to the ribbon or band feed type of lamp and is made in sizes ranging from one ampere to thirty-five amperes. One of the advantages of this type of lamp lies in the shortness of the lamp. The upper carbon holder is held by guides which slide down the inner surface of the frame, and is supported by a copper band which also conducts the current to the upper carbon. As shown in the accompanying cut the supports **c** carry an inclined plane which supports the drum **b**. This frame also supports the pinion wheels with the escapement and at the upper end the cross piece which is the iron armature. The electromagnet and the weight of the upper carbon and holder draw the frame downward, while the spring **f** pulls in the opposite direction. The unwinding of the copper band causes the drum and the pinion wheels to revolve, while the escapement and lever oscilates rapidly. When the frame is near its highest position a tongue-piece projecting from the lever **a**, strikes the stop and the motion of the clockwork ceases. When the frame is drawn down by the electromagnet which is strengthened by a greater amount of current passing through the shunt, the copper band is drawn down by their weight. As this current decreases the strength of the magnet decreases and the frame is drawn up by the spring to where it strikes the stop. The arc lengthens and the resistance increases throwing more current through the shunt which draws down the frame and allows the carbon to descend as before. The operation is not complicated and the regulation is quickly effected. The number of sizes, small and large, enables the consumer to secure a most economical light. The one ampere lamp has nearly double the candle power of the 16 candle power incandescent while the current consumed is about the same and the other sizes in proportion.

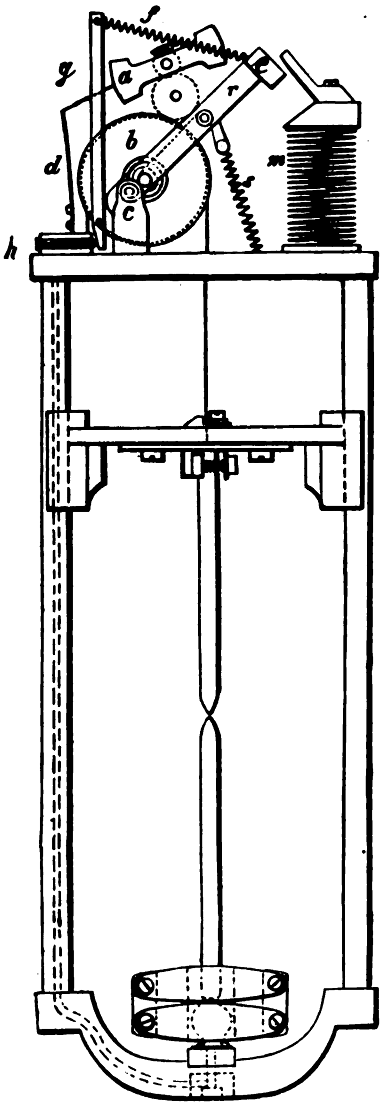
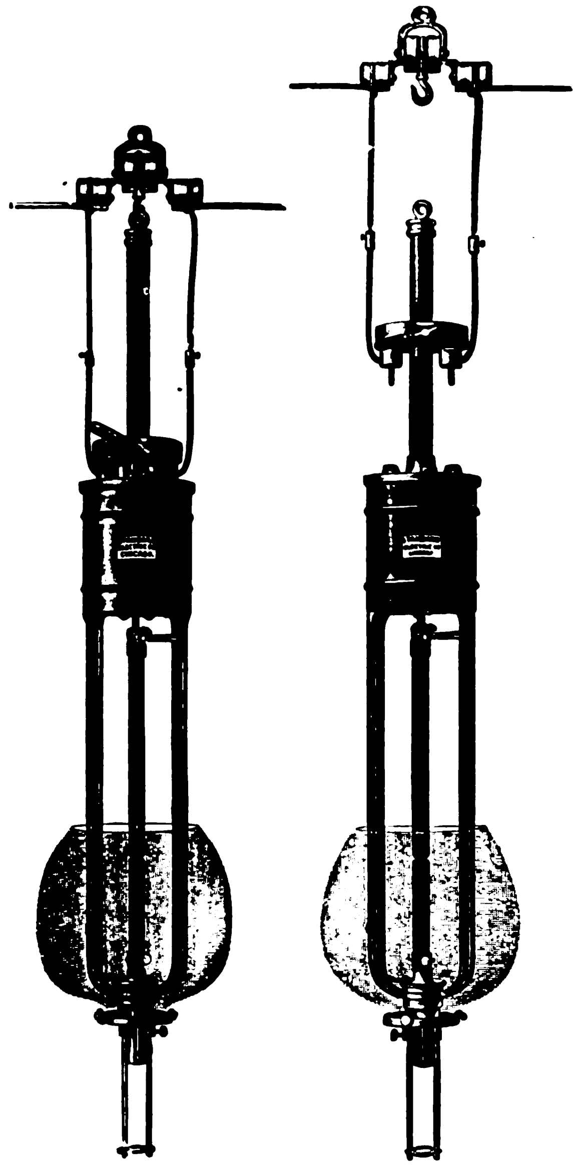


Fig. 2.

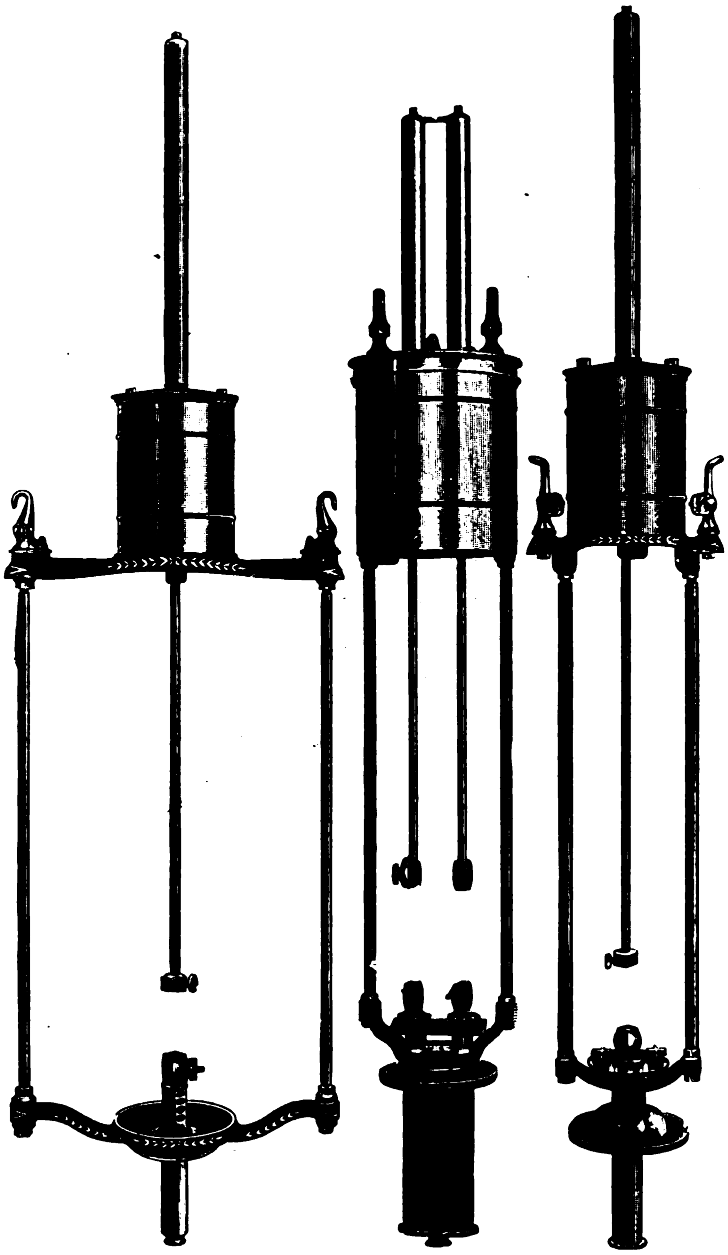
FIG. 33.—THE ARC LAMP—SIEMENS & HALSKE.



FIGS. 34-35.—THE STANDARD ARC LAMP.

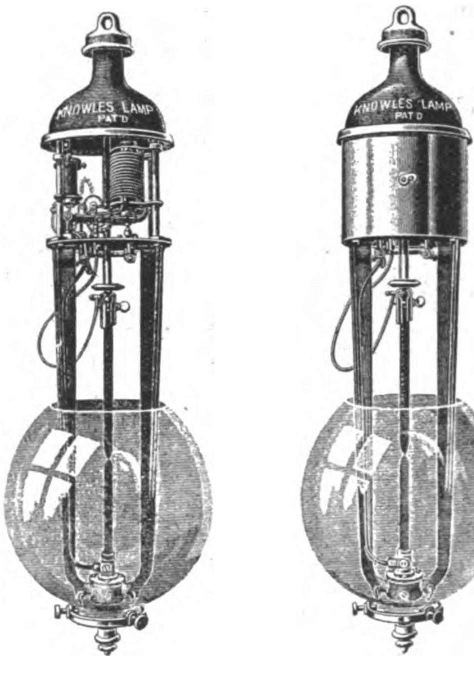
Since the Standard arc lamp was placed on the market in connection with the Standard system of arc lighting it has enjoyed an extensive sale. As the excellence of their construction was demonstrated in practical use the arc lamps of the Standard Electric Company found their way into the stations especially of the south and west. The lamps were designed with special reference to the requirements of the central station and the lamps manufactured are such as the central station manager or superintendent of the isolated plant can install and operate to advantage. With slight modifications the out door lamp, a weather-proof lamp, is made suitable for the interior. The mechanism of the lamp is simple and gives an even feed to the carbons. A quick and easy adjustment of the arc is effected without the flickering of the light. In the double service lamps an all night lamp is secured with a single regulating mechanism by the use of oval carbons which are manufactured especially for the company. The arc moves back and forth forth across the face of the carbons, consuming gradually the carbons which last twice the time of the ordinary carbons. By the use of this lamp there is but one mechanism to keep in repair, but one to clean and but one set of carbons to be renewed. The company has added to the lamp a number of features that add to the facility with which the lamps are handled. The automatic hanger and cut-out has been found a most convenient adjunct. By its use the lamp is automatically released from the circuit and can be lowered by the cord for trimming. It places the lamp in the hands of the trimmer entirely free from the circuit and the safety of the trimmer is thus assured. A noticeable thing about the hanger is the absence of all slack wire. The circuit wire is drawn tight and fastened to the insulators on the hanger board. Other devices of a similar character are also manufactured by the company.

Among the manufacturers of arc lamps the Western Electric Co. holds a prominent place. The arc lamps of this company are largely used in the central stations covered by its extensive trade. The line of lamps manufactured include those for nearly every purpose for which the lamp is used, arc lamps for the different currents, theater lamps and focusing lamps each of which are characterized by the simplicity and durability of the regulating mechanism. The designs and mechanical details of the lamps show the great skill of the originators. All parts are made from standard patterns and are thus interchangeable, facilitating repair should any be necessary. In the lamp for arc circuits the carbon rod is fed by means of a double clutch which grasps both sides of the carbon rod. This clutch is attached to a lever, actuated by electromagnets. When the current is turned on the electromagnets draw their armatures which are connected through the levers to the clutch causing the carbon rod to be raised and the carbon points to be drawn apart. The arc is thus formed. The release of the lever by the increase of the resistance of the arc releases the clutch and the rod falls by gravity, when as in the previous case the carbons are again drawn apart. A dash pot prevents any vibration of the rod and a steady light is assured. In the double lamp, two exactly similar mechanisms are used. When the current is turned on, one set of carbons burn and continue to burn until they are consumed, when they are thrown out of circuit and the other two thrown in. In the lamp designed for constant potential circuits a rack feed is employed which is composed of few parts, and which give an easy and steady regulation of the arc. All parts are positive in action and are sensitive to slight changes in the current. The lamps are adjustable between certain ranges of voltage. For interior lighting special brass trimmings are manufactured which give the lamps a neater appearance. The frame and housing of the lamps for out door service are water tight so that no extra protection in the shape of hoods, etc., is necessary. The company also manufacture all the accessories necessary in the operation of the arc lamp. The line of electric street posts, brackets, etc., embrace an extensive variety.



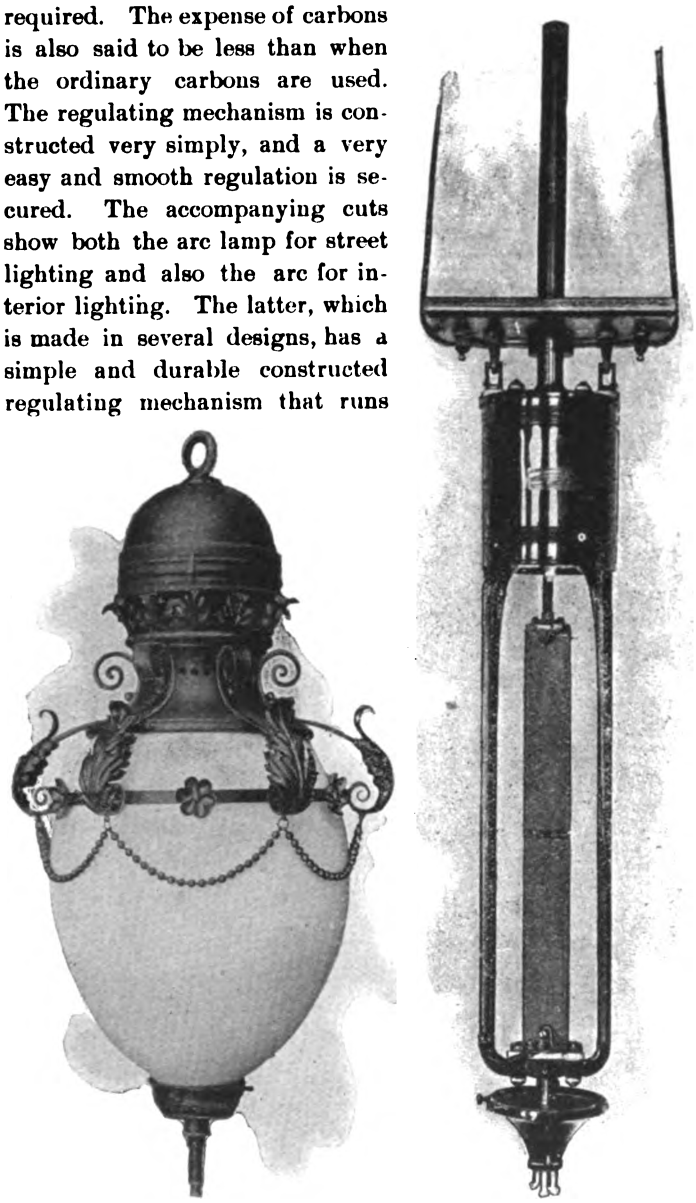
FIGS. 36-38.—THE ARC LAMP.—THE WESTERN ELECTRIC.

The Schuyler arc lamps have been greatly improved since they were first placed on the market by the Schuyler Electric Company of Middletown, Conn. The construction of the lamp is such that the carbon points are only allowed to descend a predetermined length at a time, the feeding mechanism being controlled by an exceedingly simple but effective device. The arrangement is sensitive without being complicated or too delicate. The carbon rod is constantly under control and is moved by almost imperceptible degrees. It can be depended upon to maintain the proper distance between the carbon points. The lamp contains an automatic cut-out that in case of accident to the lamp throws it immediately out of circuit, the remaining lamps being unaffected. Single and double lamps are manufactured to supply the requirements of a long or short time lamp. The single lamps will burn seven or eight hours while the double lamps burn twice as long. The arc lamp for incandescent circuits is designed to run two in series on circuits of a potential between 100 and 115 volts with a proper rheostat for controlling any slight variation in voltage. If but one lamp is used it will require 50 volts in series with a special rheostat. Each lamp is adjusted for seven and one half amperes. The lamp is compactly built and is made waterproof for use out of doors. No hoods or other protecting device is necessary. The globes are easily removed for trimming or cleaning. The lamp is easily adjusted to adapt it for different currents. The alternating current arc lamp is similar in construction to the direct current and a single lamp is placed on a 52 volt alternating current circuit just as on the direct current circuit. In this lamp cored carbons are advised for both upper and lower carbons.



FIGS. 39-40.—THE SCHUYLER LAMP.

With great confidence in the alternating current for lighting the Westinghouse Electric & Mfg. Co. has perfected and for several years has had on the market very efficient systems of lighting. The arc lamps for the system of arc lighting have been designed with special reference to the requirements of the service. The burning of the carbons and the distribution of the light have been carefully considered, and the lamps manufactured seem to fill the conditions in every way. For street lighting a very efficient and long life lamp is manufactured, burning a special form of carbons. These carbons are flat, about one half inch thick and one and two inches wide. The upper and lower carbons are alike since on the alternating current circuit both are consumed with equal rapidity. The carbons one inch wide burn from fifteen to eighteen hours, while the broad two inch carbons will burn from thirty to thirty-six hours. It is said that with the latter the lamps require trimming but once in two or three days, thus reducing in a corresponding ratio the number of trimmers required. The expense of carbons is also said to be less than when the ordinary carbons are used. The regulating mechanism is constructed very simply, and a very easy and smooth regulation is secured. The accompanying cuts show both the arc lamp for street lighting and also the arc for interior lighting. The latter, which is made in several designs, has a simple and durable constructed regulating mechanism that runs almost noiseless on a current of proper frequency. This style of lamp was used in large numbers at the World's Fair at which place many of our readers undoubtedly noticed them. The neat and tasty design of the lamp speaks for itself.



FIGS. 41-42.—THE ARC LAMP.—WESTINGHOUSE.

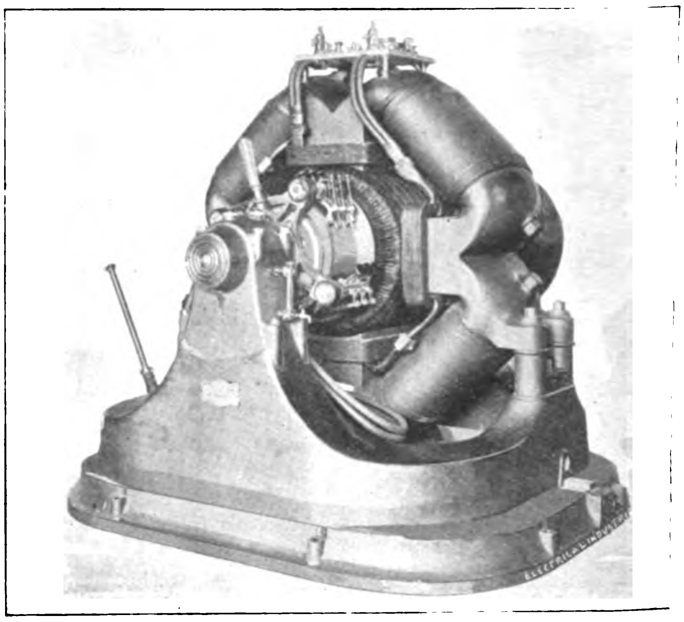
The Northwestern Electrical Association.

The second annual convention of the Northwestern Electrical Association held at Milwaukee, January 17 and 18 was considered the most successful meeting of the Association. About 75 delegates attended. Wednesday afternoon the convention listened to an address of welcome by Mayor Koch, of Milwaukee. Ex-senator Merrill, of Ashland responded to the address, after which Mr. W. N. Stewart presented his paper on the "Advantages of the Directed Connected Direct Current Generators." At the evening session the election of officers for the ensuing year took place. Mr. C. C. Paige, Oshkosh, Wis., was elected president; Mr. H. C. Thom, of Madison, secretary, and Mr. G. F. Merrill, of Ashland, treasurer. St. Paul was selected for the July meeting.

The remainder of the evening was taken up with the reading and discussion of the paper by Prof. D. C. Jackson, of Madison, on "Essential Station Instruments." Thursday's sessions were devoted to a paper on "New Things in Electricity," by W. W. Low, of Chicago; two papers on "Economical Use of Transformers," by Mr. Formen Collins, and Mr. J. McFadden, a paper by E. L. Bedell, on "Corlis Compound Engines," and a paper on the "Trend of Electrical Investment," by Mr. H. C. Thom. Thursday evening was set apart for the banquet which was greatly enjoyed by those in attendance. Mr. H. C. Thom made a capital toastmaster, and the responses were highly appreciated.

New Standard Dynamo.

The Standard Electric Company of Chicago, which has been well known to the trade through the standard system of arc lighting, has just placed on the market a new direct current dynamo. A glance at the accompanying cut will show the excellent proportions of the machine. In the insulation and winding of the coils the greatest care has been taken to produce a highly efficient machine. The latest devices for lubricating the revolving parts are employed. The brushes and holders are of a very neat and substantial design. The machine will undoubtedly at once take a prominent place on the market.



NEW STANDARD DYNAMO.

Electrical firms and those connected with the electrical trade generally are buyers of the best goods in whatever line. In conducting the affairs of this modern and progressive industry the more advanced methods and appurtenances are employed. When it is known that out of a dozen different makes on the market nearly 90 per cent of the total used by the trade are of one manufacture, it is a good testimonial to the Remington Typewriter.

Improved Engine of the American Engine Co.

The large manufacturing plant at Bound Brook, N. J., formerly owned and operated by The American High Speed Engine Co. has been purchased by the American Engine Co. This company is now building a high-grade Automatic Engine in both the horizontal and vertical patterns. The accompanying cuts show the horizontal engine. In Fig. 1 is shown a section through cylinder. The valves used are E. F. Spaulding's patent and secure an automatic cut-off. The valve consists of a flat face slide valve bearing upon a flat seat, against which it is held by the steam pressure. The valve always remains tight on account of the uniform wear of the faces. This valve controls the admission and release, while the cut-off is accomplished by a small cylinder valve within the slide valve.

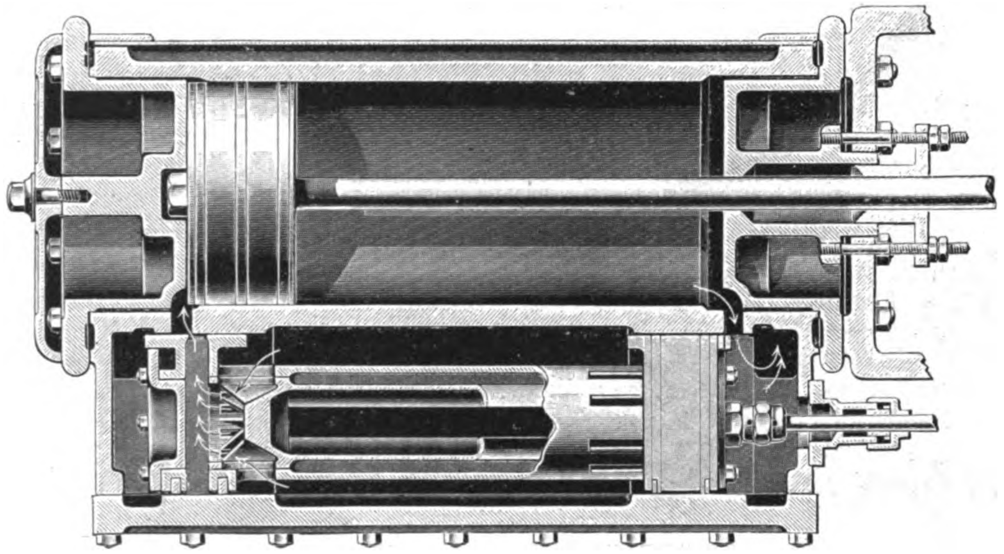


FIG. 1.—IMPROVED ENGINE OF THE AMERICAN ENGINE CO.

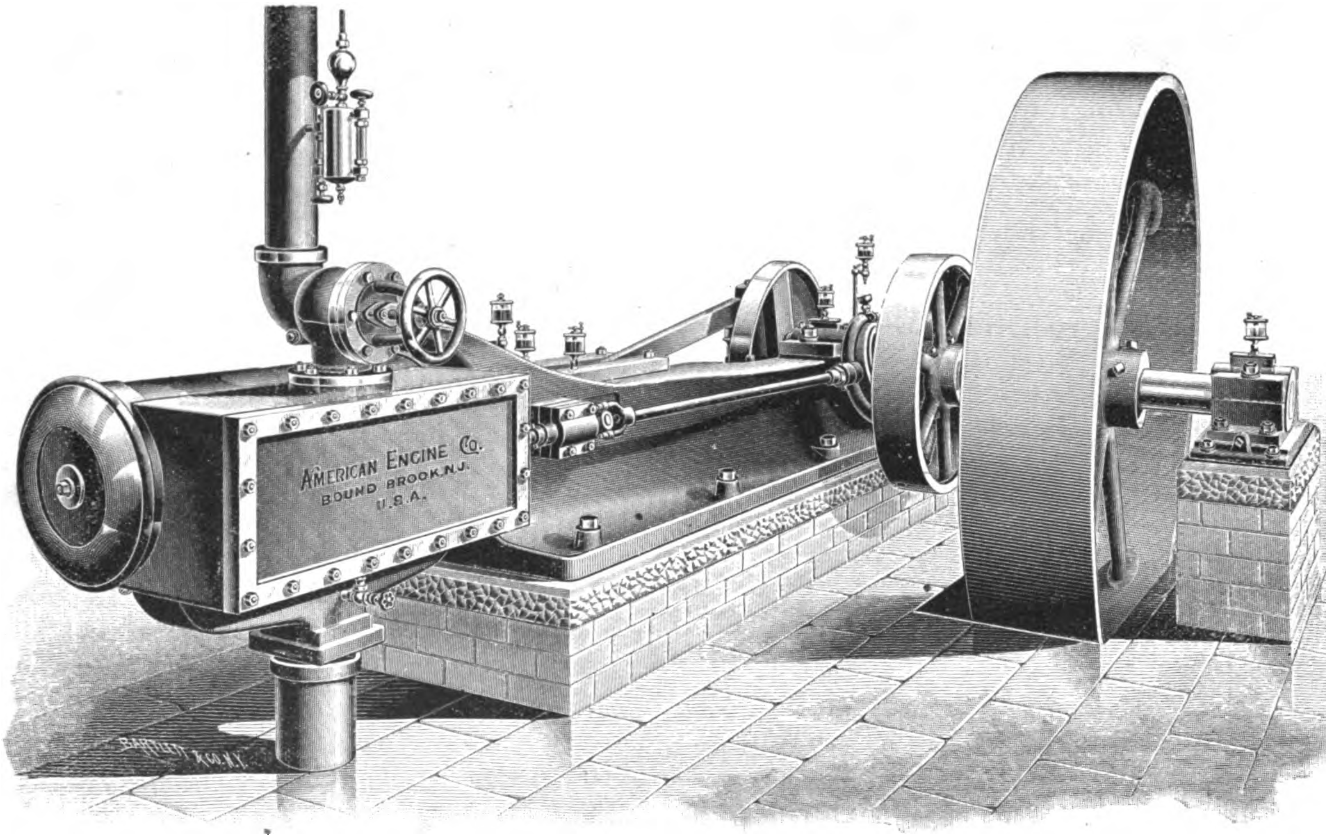
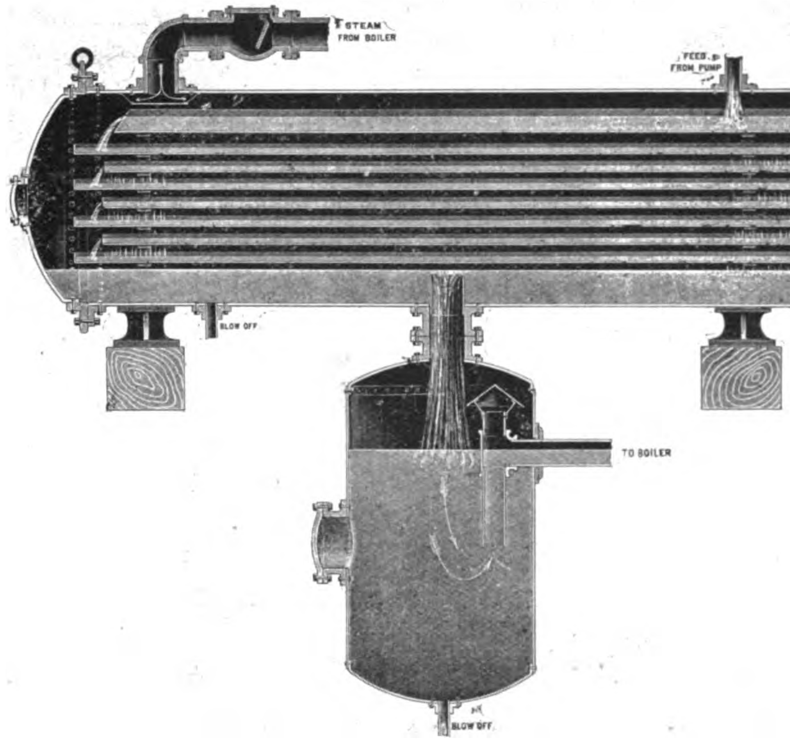

American Engine Co.
Bound Brook, N.J.
U.S.A.

FIG. 2.—IMPROVED ENGINE OF THE AMERICAN ENGINE CO.

The latter valve is provided with ports and corresponding longitudinal ports are cast through the shell of the slide valve. The cutting off of the steam is effected by twisting or rotating the valve which opens and closes the longitudinal ports. Upon the eccentric which is keyed to the shaft, there is a sleeve free to turn and connected to the governor arms. In this sleeve is turned a diagonal V-shaped groove in which is fitted the eccentric strap. As the sleeve revolves with the eccentric, being carried around by the governor, a twisting motion is imparted to the eccentric strap and through the eccentric rod and valve rod to the valve. The value turning by this method the ports are opened and closed. Thus two motions are transmitted through the rod to the valves; a motion produced by the motion of the fixed eccentric and a motion produced by the moving of the sleeve of the eccentric which motion is varied by the weights of the governor whenever the speed of the engine changes. The course of the steam in the cylinder is shown in Fig. 1. The exhaust passes below through the exhaust pipe the connections of which are cast on the under side of the steam chest. The live steam pipe enters the steam chest from above.

The packing of the joints of the cylinder and chest is effected in a simple manner, the pressure of the steam holding the surfaces in contact. The engines show excellent workmanship throughout. The engine, as shown in cut, has a broad massive bed plate giving it a firm and rigid support. A bead that extends around the edge of the base conducts all oil and water to a pit from which it is drawn off for filtering. The engines are equipped with the latest styles of lubricating devices. Engines of either medium or high speed are manufactured in both styles of which the cut-off is effected in the same way but in the high speed engines a piston valve is used instead of a slide valve.

The Baragwanath Feed Water Superheater and Purifier.



THE BARAGWANATH FEEDWATER SUPERHEATER AND PURIFIER.

At the present time of sharp competition and business depression careful attention is given to the expense account. To reduce the cost of production is one of the aims in every establishment. In electric light, power and railway stations how to secure the greatest amount of power out of every ton of coal is a problem which is always present with the manager. The general curtailment of expenses on the part of the public causing a reduction in the number of customers, demands increased efforts if the regular dividends are to be earned the coming year.

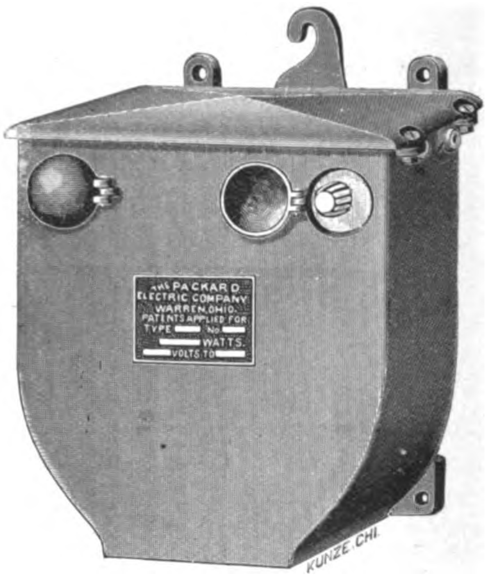
A thorough inspection of the plant is the first move in this direction. An examination of the different apparatus in a power station should indicate how well the station is equipped to secure its most efficient operation. The boilers and engines may be of the best but the desired result cannot always be obtained. It is well known to every one at all acquainted with a steam plant that the exhaust from the engine is still hot and that that heat is lost the minute it escapes into the air. It is also evident that so far as that heat is utilized to such an extent is the amount of coal consumed reduced. No method has as yet been devised that utilizes this heat so well as the exhaust steam feed water heater. But unless this heater purifies the water a defect is apparent in the scale and deposits in the boiler which prevent the full heat of the furnace reaching the water.

If the water is introduced directly to the boiler from the source of supply and the exhaust not utilized both evils are present. It sometimes happens that the exhaust is not available. For such plants or when the exhaust heater does not purify the feed water, Wm. Baragwanath & Son, 52 West Division street, Chicago, has perfected and placed on the market a live steam feed-water superheater and purifier. By referring to the accompanying cut the general design of the heater may be noted. It consists of a shell of heavy boiler iron with removable heads. Arranged on supports are a number of shelves or pans slightly inclined so as to give the water a current back and forth the length of the heater. The water is thus brought in immediate contact with the live steam. It is heated to nearly the same temperature as the water in the boiler and the impurities are deposited in the shape of scale on the pans or as mud in the bottom of the heater.

After passing back and forth over the pans the water falls to the bottom of the heater where it is drawn off into the settling chamber. Suitable blow-offs and hand holds are provided for inspecting and cleaning the heater. When the shelves have become coated with scale the heads are taken off, the pans taken out and the scale removed. The heater is placed at an elevation above that of the boiler so that the water flows from the heater to the boiler by gravity alone. These heaters are made in any size desired and are made in styles to suit the character of the water used.

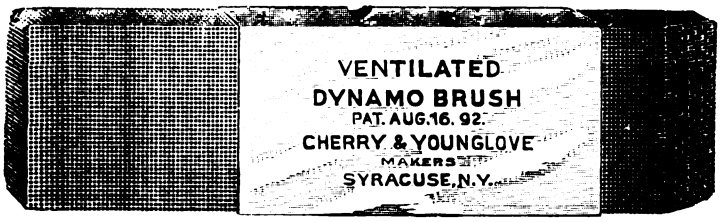
New Packard Transformer.

Since the more general use of the alternating current the manufacture of transformers has been brought to a high degree of perfection. Better methods of winding and arranging the coils and better insulation has produced more efficient transformers. The accompanying cut illustrates the Packard transformer for which the Electric Appliance Co., Chicago, is general selling agent.


THE PACKARD ELECTRIC COMPANY WARREN, OHIO. PATENTS APPLIED FOR
TYPE No.
WATTS.
VOLTS TO
KUNZE CHI.

NEW PACKARD TRANSFORMER.

It has a neat outward appearance, is strong and perfectly weatherproof. The compact arrangement of the different parts gives it also a compact form. The connections are quickly and easily made. The fusing arrangement is conveniently located. By throwing back the small covers as shown in the cut two porcelain plugs are exposed that carry the fuse wires. The plugs may be withdrawn and re-fused or new plugs inserted without danger to the attendant. The circular or ring form of coil has been adopted, and the coils are so proportioned as to give the most efficient results. In the matter of insulation the latest practice is followed throughout.



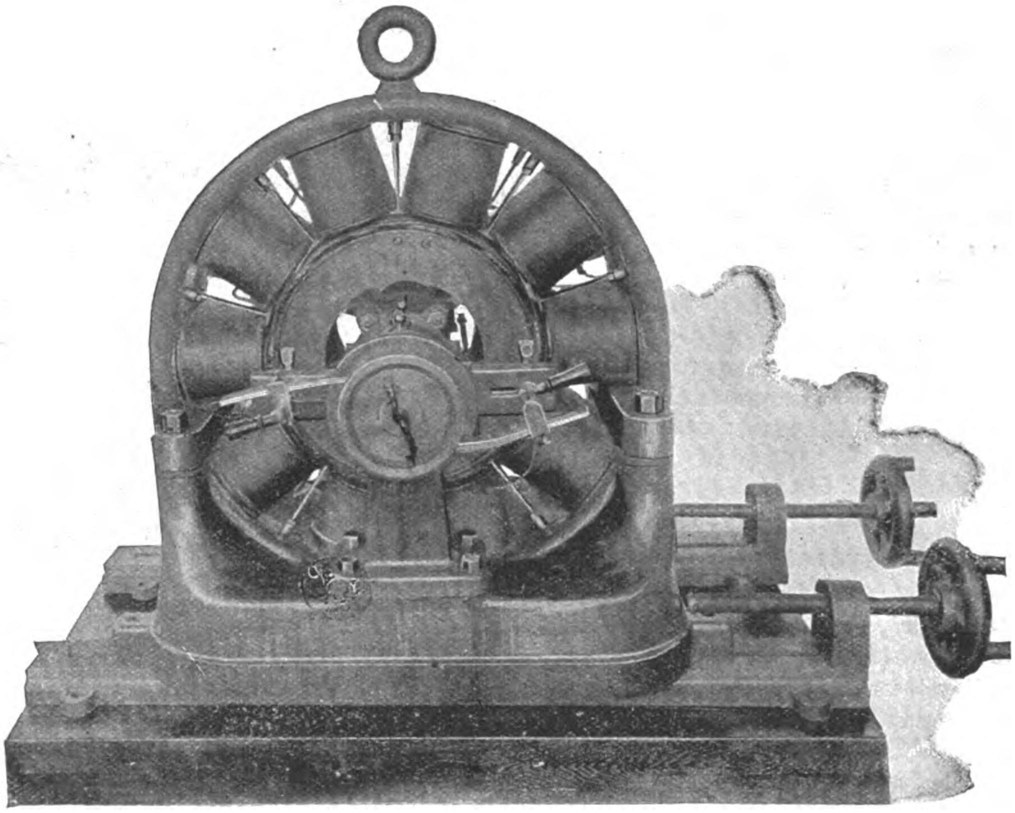
The work is done under the personal supervision of Messrs. Packard, the manufacturers of the well known Packard lamp. Everything necessary for the production of apparatus of this kind is possessed by the company. Expert mechanics are employed who carry out the ideas of the engineers of the company. The efforts of the manufacturers has been to produce a transformer that could be easily repaired and yet one that would be sufficiently durable to make repairs unnecessary. It has been subjected to severe tests that have shown that it is not to be burned out under any ordinary conditions.

The Cherry-Younglove Dynamo Brush.

Considerable attention has been given to the construction of the brushes for dynamos, seeking to overcome the defects apparent in the ordinary forms of brush. Working in this direction, Messrs. H. H. Cherry and S. D. Younglove, of Syracuse, N. Y., have perfected a brush which they now have on the market, and which is reported by users to possess advantages essential to the perfect operation of the dynamo. In their statement of the brush the makers say: Our patented construction of a dynamo brush ensures a brush embodying requisite ventilation, sufficient elasticity, ready and positive longitudinal adjustment and of simplified formation, fully incorporating the features essential to the production of a durable, efficient, practical and simple working brush. The feature of ventilation is new as employed in the construction of these brushes. It is said that the openings will not gum up or become clogged by particles of dust, as the current of air keeps the brush cool and carries the dust away. The brush adapts itself to the shape of the armature and does not require the attention necessary with many kinds of brushes.

New Bain Alternating Dynamo.

With characteristic enterprise the Great Western M'f'g Co., of Chicago, has placed on the market this season a number of improved types of dynamos, one of which is shown in the accompanying illustration. This dynamo is an alternator, embracing in its design the latest improvements and practice in alternating current machines. The experience of the company has enabled a most careful study to be made of the requirements of such a machine. In the design of the different parts such lines alone have been followed as practice has shown to be most efficient and durable. It is this attention to the details of the dynamo to which the excellence of the machine is due. The frame has been designed with a view of giving a firm and rigid construction. The center of gravity is placed low, which prevents vibration and insures a steady running. The armature coils are wound with copper ribbon and are so arranged as to be easily replaced. The form of armature gives an excellent ventilation. The regulation of the dynamo is effected to a very exact degree by a very ingenious arrangement which adapts itself to the ordinary conditions of practical operation. The strength of the field is auto-



NEW BAIN ALTERNATING DYMAMO.

matically adjusted through the exciter, varying the strength of the fields as the changes of load demand.

Cutter's New Pole Pulley.

Those who have tried to fasten an ordinary pulley, or even a rigid pole pulley to the average pole, will know how hard it is to get this into line with the center pulley and the suspension cable, even when care is taken in putting it up, the chances are that the pulley will be a trifle out of line, so that the rope will chafe on the edge of the casing. This not only adds to the labor when raising and lowering the lamp, but also wears out the rope in a comparatively short time.

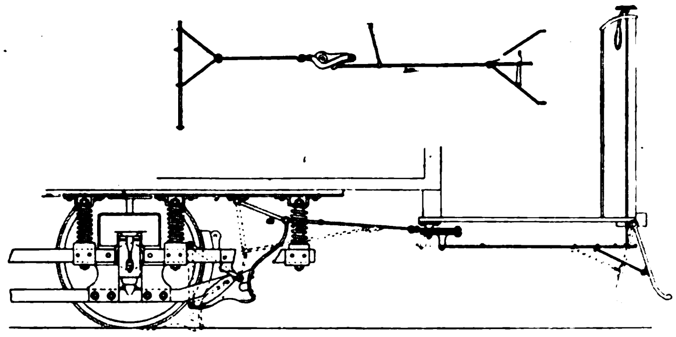
CUTTER'S NEW POLE PULLEY.

To avoid these troubles, George Cutter has designed a swivel pole pulley, the improved form of which is shown in our cut. This has a curved wall plate from which the pulley is swiveled so that it can readily swing into line with the hoisting rope. The wall-plate is made of malleable iron, and when secured to the pole by a couple of lag screws, makes a strong and quite rigid support for the pulley. The whole device is neat and well built, and judging by the extensive use of the older form, this new swivel pole pulley will meet a quite general demand. George Cutter of Chicago is the sole maker.

An Automatic Brake and Fender for Street Cars.

In the accompanying cut is illustrated an automatic brake and fender, the invention of D. McFarland Moore of New York. The device is brought forth not as being new in detail, but as a new combination involving the necessary requirements in an apparatus of this kind. Such a device should cut off the source of power which propels the car, brake the car in the most effective manner and absolutely prevent anything from being crushed beneath the car. It should be simple in construction, always in working order and inexpensive. All of these various requirements it has been attempted to meet in this device.

This device is operated automatically by pressure upon the hinged projecting fender, or by the motorman at will. Either method moves the rod under the car-platform, cuts off the current or releases the cable and swings the shoes down upon the track under the wheels, which run up slightly on the shoes, blocking the car. It is evidently impossible for anything to get under the wheels, and it is equally evident that the car cannot be more effectually braked, practically, in any other manner, for the heavier the load, the more effective the braking, particularly if the under surface of the shoe is slightly roughened, and for this purpose the shoe may preferably be constructed so that the roughened surface bears upon any desired part of the rail to prevent excessive wear. The shoes on either side of the car may be connected with a light wire fender, to keep anything from getting under the body of the car, or if preferred the usual board fender may be fastened directly upon the shoes.

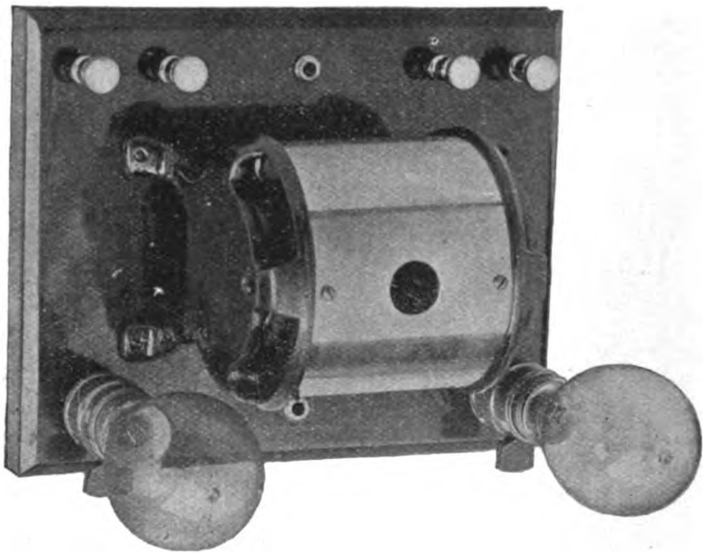


AN AUTOMATIC BRAKE AND FENDER FOR STREET CARS.

The mechanism at the point directly under the front of the body of the car where the rod running from the hinged fender connects with the rod running to the shoes—separately shown in the cut—is a simple lever, for the purpose of obtaining greater movement, and of throwing the weight of the shoes upon a dead centre, it being kept there by the slight spring shown in the cut. This arrangement keeps the shoes in their proper position when raised, offers a ready means of adjustment both as to movement of parts and delicacy of action, and prevents any operation except in the manner appointed.

Acoustic Synchronizer for Alternating Machines.

The use of alternating current machines run in parallel has created a demand for a device that will indicate the exact point of synchronism in speed and coincidence of phase of the two machines. To meet this demand the General Electric Co. has brought forth the acoustic synchronizer shown in the accompanying cut. It consists merely of a cylindrical iron case with an aperture in the side, each end being closed by flexible diaphragms, each of which has, opposite its center, the pole of an electro magnet. In using this device one of the magnets is connected in circuit through a transformer with each of the machines to be run in synchronism. The current is then turned into the magnet coils, and the diaphragms emit a loud, clear note. As the machines approach synchronism, the notes from the diaphragms approach closer in period and begin that loud, periodic sound, known in music as beats. As the two machines more nearly approach synchronous speed, the beats grow slower and slower, until finally the diaphragms fall into unison and each gives out the same low, clear note. At this moment, which is sharply marked, the switch connecting the two machines should be thrown in. So sensitive and distinct is the indication of approach of synchronism, that it is possible to throw two machines together with hardly a quiver upon the ammeter in actual circuit. The device has been found very satisfactory and accurate to a surprisingly fine degree.



ACOUSTIC SYNCHRONIZER FOR ALTERNATING CURRENT MACHINES.

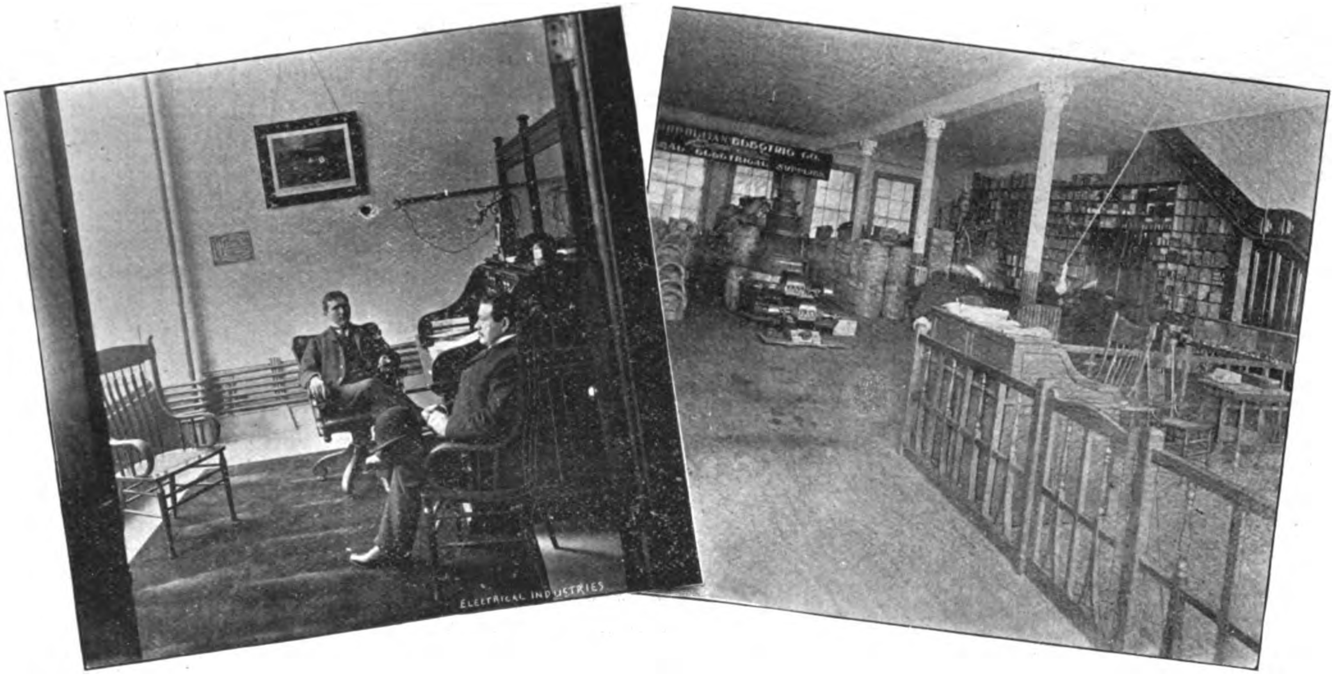
The Metropolitan Electric Company.

In a previous issue appeared a sketch of the officers of the Metropolitan Electric Company, together with portraits. In the accompanying engravings appear views of the offices and salesrooms at 186 and 188 Fifth Ave., which have recently been fitted up and are now occupied by the company. The accommodations and facilities for conducting the extensive supply business already established are ample in every respect.

In Fig. 1 is shown a view of the president's private office, which is situated to the left of the main entrance, in easy communication with the offices of the bookkeeper, correspondence and mailing departments, while directly opposite is the sales office. It is well lighted, pleasant, private, but not secluded. The bookkeeper's and cashier's office has been so arranged as to give it light and such accommodations as to facilitate the work of that department. The correspondence and mailing departments are equipped with such modern devices as have become necessary in the transaction of a large business.

The sales department occupies a large space in the front of the store. It is enclosed by a neat and nicely finished railing, carpeted and furnished with desks, chairs, etc., affording not only what is required by the chief and his assistants in this department, but also a stopping place for the out-of-town customers. The balance of the ground floor is occupied by the shipping department, accommodation for the local trade and the display of an extensive line of samples. To enter into a detailed description of the various features of the headquarters of this company, which in a few months has taken rank as one of the leading supply houses of the country, would fail to give the reader as good an idea as a personal visit. It is not always the fine offices nor extensive appointments, commodious salesrooms and warerooms that serve the trade, but to these must be added intelligent officers and salesmen acquainted with the wants of the trade, quick to see and always ready to supply the required goods. A courteous manner is another important item in business transactions. It is this more than anything else that has helped to so quickly build up the business of this house.

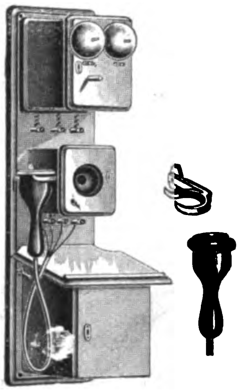
The long experience of the president, Mr. W. H. McKinlock, in the electrical trade and his extended acquaintance has secured for the house most favorable connections with the manufacturers in the different parts of the country, whose line of products has in several instances been increased to meet more fully the demands of their trade.



FIGS. 1–2.—THE METROPOLITAN ELECTRIC COMPANY.

The McKelvey Telephone.

The accompanying cut shows a telephone, the invention of Mr. S. D. McKelvey, of Canton, Ohio, to whom patents have been issued. The general appearance of this telephone is the same as the well known form now in use, which form, however, will be modified for the purposes it is intended to be used. The illustration herewith shows telephone intended for exchange purposes, and for private lines. Mr. McKelvey has also secured letters patent on a system of "Shop phones," which are designed especially for use in factories, stores, hotels and other large buildings, the system of which is so arranged that any sub-station may communicate with any other sub-station without employing a central office.



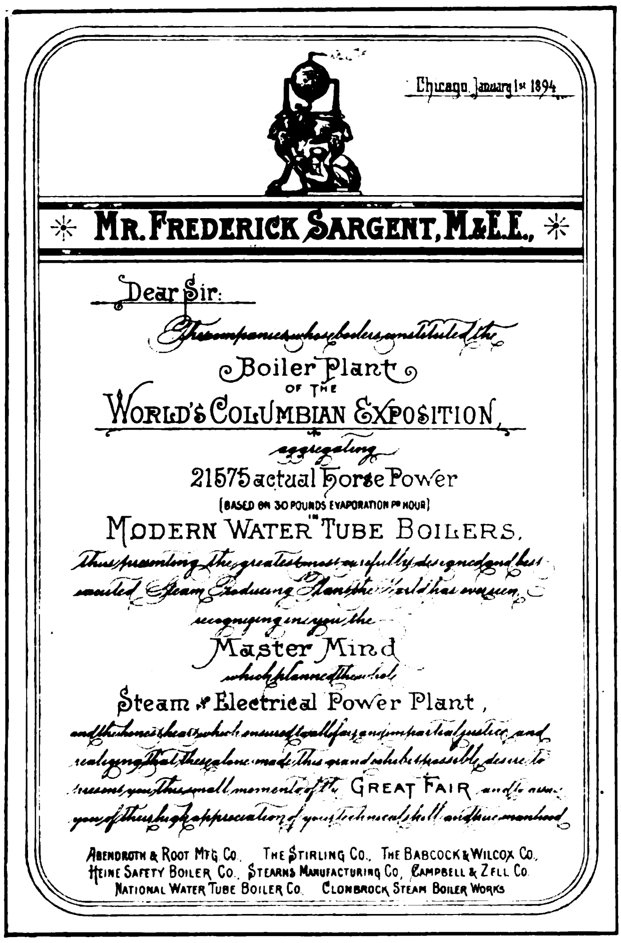
MC KELVEY TELEPHONE.

These telephones are said to be constructed on new lines and are entirely unlike the present form. They have been tried on a line 115 miles long, using a ground return and satisfactory results obtained. On these experimental lines a dry battery has been used during the past eighteen months, which has been constructed for telephone and open circuit work. A number of other auxiliary devices have been invented by Mr. McKelvey. A one-third interest in these patents is held by Mr. J. A. Linville, with whom Mr. McKelvey will undertake the manufacture of the telephones and apparatus.

Jas. Quinne, manager of the Yreka Electric Light Company, Yreka, Cal., in renewing his subscription for 1894, says: "Your paper is a necessity and worth the money."

The Boiler Manufacturers Express Their Appreciation.

The boiler manufacturers whose boilers composed the boiler plant at the World's Fair recently presented Mr. Frederick Sargent with the accompanying memento engraved on parchment and enclosed in a handsome white and gold frame. The presentation was done quietly, without any ceremony and it will be carefully preserved by Mr. Sargent as an expression of the appreciation of the boiler companies whose names it bears. The arduous service performed by Mr. Sargent in the planning and construction of the great power plant and the extensive system of power transmission were never fully realized except by those actively engaged in the work of construction. After the successful termination of the Fair business rivalry is entirely forgotten in contemplating the success of the great undertaking and in rendering credit to those by whom it was planned and constructed. The boiler plant excited the admiration of engineers from all parts of the world and reflected great credit on its designer.



Chicago January 1st 1894.

MR. FREDERICK SARGENT, M.&E.E.,

Dear Sir:

The companies whose boilers constituted the

Boiler Plant
of the
World's Columbian Exposition,
aggregating
21575 actual Horse Power
(based on 30 pounds evaporation per hour)
in
Modern Water Tube Boilers,
thus presenting the greatest most carefully designed and best installed Steam Producing Plant the World has ever seen,
recognizing in you the
Master Mind
which planned the whole
Steam & Electrical Power Plant,
and the honest heart which ensured to all fair and impartial justice, and realizing that these alone made this grand whole possible desire to present you this small memento of the GREAT FAIR and to assure you of their high appreciation of your technical skill and true manhood.

Abendroth & Root Mfg. Co. The Stirling Co. The Babcock & Wilcox Co.
Heine Safety Boiler Co. Stearns Manufacturing Co. Campbell & Zell Co.
National Water Tube Boiler Co. Clonbrock Steam Boiler Works

ODDS AND ENDS.

The city council of Baltimore has passed an ordinance requiring all city passenger railways to place in front of every car a proper guard or fender to prevent as far as possible accidents to persons or animals.

The postmaster at Ottawa reports that the new mail cars which convey the mails from the postoffice to the railway depots are a success in every way. Convenience in handling the mail and time in conveying it to the train are secured by this plan.

The suit of the Western Electric Company against the General Electric Company and E. J. Spencer for damages for the destruction of signs at the World's Fair has been amicably settled out of court, the interested parties expressing themselves as being entirely satisfied.

The final act in the transfer of all street railways in Milwaukee to the Milwaukee Street Railway Company took place on January 29th. The last payment of $335,000 and the transfer of the deed of the West Side railway places the street railways of Milwaukee under one management.

On January first an important event occurred in the commercial history of Manchester, Eng., the opening of the Manchester ship canal. The largest vessels can now unload at the docks at Manchester. The canal was commenced in 1887 and has just been completed. It cost about seventy-five million dollars.

The Chicago headquarters of the General Electric Company on Adams street, are to be abandoned. These offices were formerly occupied by the Edison General Electric Co., which went to a great deal of expense in fitting them up. Offices of the sales department are to be opened on the tenth floor of the Monadnock Block. The other departments will go to Schenectady.

The Consolidated Car-Heating Co. of Albany has begun suit in the United States Circuit Court against the Chicago & West Michigan Railway for infringement of the Sewall coupler patents. The infringement alleged consists of using an imitation of the Sewall steam coupler recently put upon the market. After proper notification the Consolidated Car-Heating Co. determined to take action to protect the patents issued to Messrs. D. D. and J. H. Sewall.

Funny things happen every day in the electrical business. An electrical manufacturing company in Chicago recently received the following letter: "Please send me the address of the firm who sells the small electric bottles flavored with horse-radish. I want to send for some." The letter is signed by a woman, whose address is in our possession. Perhaps some one can supply us with the information desired so that we may send it to the right party.

The first test of the Niagara Falls Power Co.'s tunnel at Niagara Falls took place on January 25th, in the presence of the officials of the Niagara Falls Paper Co. and of the R. D. Wood Co., who built the turbines. Three 1,100-horse power turbines were started which are in the paper company's power plant. The test is said to have been entirely satisfactory in every way. It is said that the turbines and generators in the power company's power house will be in place and ready to start by the coming June.

A canal boat operated by electricity from storage batteries is to be built and placed on the Erie canal, the coming summer, by Mr. Frank W. Hawley, vice-president of the Cataract Construction Co. The boat is to be of an improved design. The Westinghouse motors will be used. The Electric Storage Battery Company is to furnish one set of batteries and the General Electric Launch Co. another. It is the intention to place on the boat numerous electrical devices of practical value in every day life. The boat will thus become an electrical exhibition boat.

The suit of Prof. H. A. Rowland of Johns Hopkins University against the Cataract Construction Co. for $30,000.00 resulted in a verdict of $9,000 for the plaintiff. As a fee for his services for six months and two weeks Prof. Rowland presented a bill for $10,000, which the company considered excessive and forwarded a check for $3,500. He then brought suit for $30,000, stating that his former bill was too low. The case was watched with a good deal of interest. The witnesses present included Dr. Louis Duncon, Dr. W. W. Jaques, Prof. Coleman Sellers, Prof. Barker, Prof. George Forbes, and others.

The factory of the Smith & Davis Mfg. Co. at St. Louis, Mo., is operated entirely by electricity. The electricity is distributed through the factory from the generator to motors in different parts of the works. A compound wound T-H 100 K. W. 220 volt generator run by a low pressure engine furnishes current for the works. There are eight motors in use of almost as many different makes; of these two are Sprague motors of 20 and 25-horse power, two Rockford 15-horse power one Card of 30-horse power, two T-H. of 10 and 15-horse power and one five-horse power Wagner. Wm. Dye is the electrician of the company.

The electrical decorations at the fourth annual ball of the Massachusetts Electrical Engineers and Mechanics Association held at Copley Hall, Boston, on the 29th inst are said to have been unique. Suspended from the center of the hall was a ball seven feet in diameter, covered with red, white and blue incandescent globes. This ball revolved and a commutator on the axis turned on alternately the red, white and blue lights. From the ball to the sides of the hall reached streamers of lights that changed color with the ball. At the rear of the hall were two towers having 350 lights each. The effect of these lights can be better imagined than described.

CORRESPONDENCE.

Letters From Practical Men.

EDITOR ELECTRICAL INDUSTRIES: I want to put up three telephones in an office building—one telephone in the storeroom, one in the main office and another in the salesroom. The main office and salesroom are adjoining so that no connection desired between the two, but each desire communication is with the storeroom. How shall I connect up the permanent magnet telephones with bells and push buttons with two wires from the storeroom? Will some one kindly give me the necessary information? T. W., Chicago.

EDITOR ELECTRICAL INDUSTRIES: In an alternating current station there are two distinct classes of customers, that are styled commercial and domestic. The "commercial" are those who have stores and offices, the "domestic" refers particularly to resident lighting. The nature of the service for the two styles of customers is in a measure different. The store or office usually wants all its light for a specified time, while the resident requires only a small proportion of its light and wants it at almost any time. Now, here's the question: Does house or resident lighting pay? Cannot some central station managers give their views on this question? T. E., N. Y.

EDITOR ELECTRICAL INDUSTRIES: How can difference in potential between water and gas pipes be avoided when they are so affected by a ground return of a street railway. This is a question, I think, should be answered by some electrical expert of the insurance companies?

C. D. D., Phila.

EDITOR ELECTRICAL INDUSTRIES: Is conduit being used to any great extent for interior wiring? ARCHITECT.

EDITOR ELECTRICAL INDUSTRIES: The safe-carrying capacity for insulated wires as given by the insurance rules and adopted by the National Electric Light Association seems to be entirely too small. As the National Electric Light Association meet this coming month cannot something be done to have these safe-carrying capacities revised? I think it would meet with the approval of the insurance companies and certainly would receive the commendation of contractors. One instance of the radical change made by the present rating was the reducing of .0000 wire from 300 amperes to 175 ampere safe carrying capacity.

THOS. G. GRIER, Chicago,
Mgr. Bryant Elec. Co.

The Walker Manufacturing Co.

As evidence of the confidence of railway men in the ability of the Walker Manufacturing Co. to furnish first class dynamos and motors, the amount of business already brought to its offices is sufficient. In view of the business now under consideration the company has greatly increased its force in the electrical department. It is the intention to push the work as rapidly as possible consistent with the thorough attention to details, and to this end the company expects soon to increase its forces still farther.

Only such departures from existing practices have been made in the design and construction of the motors and generators as have been found to effectually increase the output or give additional economy in construction, the excellence of the machine being the first consideration. The armature winding of the motor possesses certain valuable innovations and improvements, of which tests have given very gratifying results. The willingness of railway builders to place their orders before a machine is actually on the market is almost without precedent. The confidence in the company, which has an established reputation in the railway field, together with the excellent record of the electrical men recently associated with the company is however sufficient guarantee of the satisfactory fulfillment of all contracts.

The facilities of the company have enabled it to accomplish in the two months since the details of construction were begun what would have taxed to the utmost the resources of almost any other company starting in a new field. Such activity serves materially to secure the confidence of business men. The officers of the company report themselves as well pleased with the outlook for spring business.

The Monadnock Block as the Electrical Center of Chicago.

One of the most pronounced features of modern business is the tendency of the various firms engaged in kindred branches of the same industry to get as near one another as possible. This is strikingly illustrated by the rapid gathering together of leading electrical firms in the Monadnock Block, Chicago, beginning with a few firms that took quarters in this building about two years ago until there are now collected under this one roof representatives of nearly all the important electrical concerns of the United States outside the city of Chicago. Mention need only be made of the Siemens & Halske Electric Company of America, the General Electric Company, etc, in order to give an idea of the class of electrical concerns already in this building.

The Monadnock Block is especially well suited to the needs of the electrical business. It is one of the famous newly erected buildings of Chicago, built with great massiveness and finished very handsomely. The offices are all light and cheerful within, the building being a very lofty one of some sixteen stories. The fact of the many conveniences of light and air no doubt accounts for the large number of representative electrical concerns within the building and it is well called the electrical center.

As its name implies, the building occupies an entire block, being surrounded by Dearborn, Jackson and Van Buren Sts., and Custom House Place, and situated in the heart of the business center of the city. It has a street frontage of about 950 feet and is claimed to be the largest office building in the world. In it are 1,200 suites of offices, 16 fast passenger elevators and four staircases. It has eight entrances from the various streets surrounding it and nearly 150 persons are employed in taking care of the building, the machinery, elevators, etc. The population of a building like this when filled is about 6,000 people and about 20,000 people it is estimated ride daily in the elevators. The management of such a building involves almost as much care as one of the great ocean liners comprising as it does, staffs of engineers, janitors, elevator men, etc., and the excellent service given is of itself sufficient proof of the competency of the captain.

McCreary's New Specialty.

The general adoption of electricity for light and power created a demand for numerous appliances and specialties which have added greatly to its efficiency and convenience. In the constant improvement both in the design and method of manufacturing these specialties, simplicity has been one of the great objects sought. In many instances it has been accomplished with increased durability and an extension of the field of usefulness.

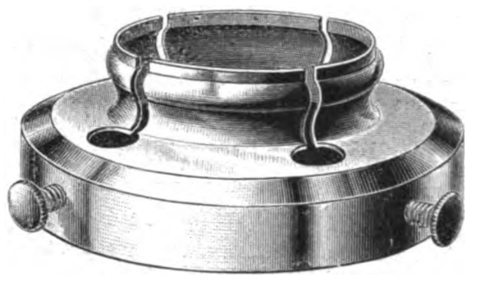


FIG. 1.—MCCREARY'S NEW SPECIALTY.

The McCreary specialties, manufactured by the McCreary Electrical Specialty Co., of 136 Liberty St., New York, which are known wherever the electric light is used, have long been favorites with the trade on account of the simplicity of their construction, the ease with which they are adjusted and their durability. The new specialty, herewith illustrated, is known as McCreary's Specialty No. 26. It is a perfect shade holder for incandescent lights. Fig. 1 shows the holder complete ready to be attached to an Edison socket. The neck of the holder, which is of stiff spring brass, fits over the ring on the Edison socket and is held firmly so that it is moved only with the socket. In Fig. 2 the holder is shown with clasp ready to be attached to a T-H or Westinghouse socket and in Fig. 3 it is shown clamped as when attached to the socket.

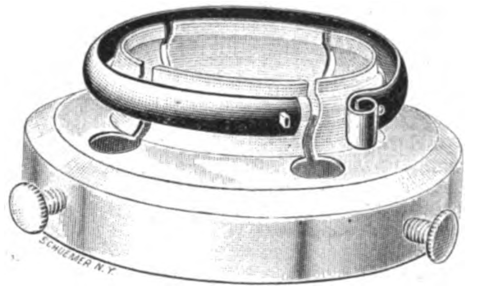

SCHOLMER N.Y.

FIG. 2.—MCCREARY'S NEW SPECIALTY.

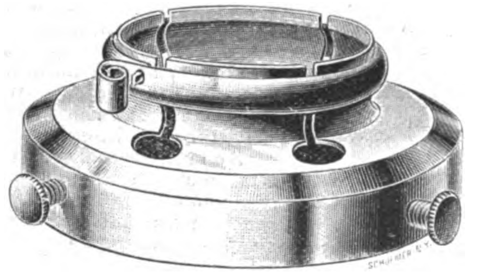

SCHOLMER N.Y.

FIG. 3.—MCCREARY'S NEW SPECIALTY.

It is made of polished brass and gives a very neat finish to the fixture. It is instantly attached to the socket and as quickly removed. No tools are required and its great simplicity is one of its good qualities. The brass is of sufficient thickness so that it is not easily injured or bent out of shape. It holds the shade firmly and still gives an abundance of room for the top of the shade. The appearance of this specialty which will permit the user of electric light to attach his own shade without the use of tools or the exercise of unusual skill will undoubtedly extend its use.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Willard, N. Y.—The Willard State Hospital will build a new plant

Lansing, Mich.—E. Bement & Sons will add an arc machine next year.

Hudson, Wis.—The Holmes Sanitarium may double its present capacity.

South Bethlehem, Pa.—Lipps & Sutton will add 250 incandescent lamps.

Bellefontaine, O.—Colton Brothers will erect a plant for city lighting, soon.

Ritchey, Mo.—The Ritchey Milling Company contemplates adding more lights.

Troy, N. Y.—The E. G. Bernard Company will increase the capacity of its plant.

Lakeview, N. J.—Mr. A. Cardinal contemplates the installation of an arc system.

Camden, N. J.—J. B. Van Seiver & Company will double the capacity of its plant.

Petersburg, Ill.—A. Abbott Sons contemplate an extension of incandescent circuit.

Gardiner, Me.—S. D. Warren & Company contemplates an enlargement of its plant.

Girard, O.—F. Krehl & Sons contemplate putting in a larger plant the coming summer.

Arrowhead Springs, Cal.—The Arrowhead Hotel Company may possibly enlarge its plant.

Syracuse, N. Y.—The Herald Company contemplate an increase of its dynamo capacity.

North Tonawanda, N. Y.—J. F. Parkes, agent, will double the capacity of his present plant.

Pella, Ia.—The Pella Electric Light & Power Company will extend circuit and add more lights.

East Chicago, Ind.—The Famous Manufacturing Company will enlarge its plant, May 1st, next.

Osceola, Nev.—The Osceola Placer Milling Company expects to duplicate its plant the coming year.

Williamsville, N. Y.—The Buffalo & Williamsville Electric Railway Company will add two motor cars.

Charlotte, N. Y.—The Grand View Beach Railroad Company will install an electric light plant soon.

Nashua, N. H.—The G. O. Sanders Lumber Company will put in a plant of 100 lights at its Hudson mill.

Lexington, N. C.—W. E. Holt will put in 200 additional incandescent lights during the summer of 1894.

Ottawa, Ont.—The Corporation of the College of Ottawa contemplates adding a new dynamo and engine.

Luray, Va.—The Luray Caverns Company will increase its arc lamp capacity. L. Zerkel is purchasing agent.

Biloxi, Miss.—The Biloxi Electric Light Company will add a power circuit. E. G. Bucklin is purchasing agent.

Yazoo, City, Miss.—The Mississippi Cotton Oil Company will add a larger dynamo. E. Schaifer is purchasing agent.

State College, Pa—The Pennsylvania College will add 200 incandescent lights. Louis E. Reber is purchasing agent.

Jamestown, S. D.—The North Dakota Insane Asylum's plant is to be materially enlarged. Ogden Lovell is purchasing agent.

Southbridge, Mass.—The American Optical Company will install an incandescent plant soon. H. C. Cady is purchasing agent.

Athens, O.—The Ohio University will largely increase its plant and equipment. John E. Snow is purchasing agent.

Owatonna, Minn.—The State Public School will increase its dynamo and engine capacity. G. A. Merrill is purchasing agent.

Croton Falls, N. Y.—George Juengst & Sons contemplate building a central station to light Croton Falls and adjacent towns.

Detroit, Mich.—The Farrand & Votey Organ Company contemplate changing its entire plant to motors and adding arc lights.

Richford, Vt.—Sweet, Cummings & Company contemplate the installation of a new water wheel. R. H. Whitman is purchasing agent.

Valleyfield, P. Q.—The Montreal Cotton Company may add a storage battery to its equipment. Louis Simpson is purchasing agent.

Pontiac, Ill.—The Pontiac Light, Heat & Power Company will double its capacity in the spring. H. A. Foster is purchasing agent.

Little Rock, Ark.—The Arkansas Electric Supply Company have been awarded the contract for installing an electric light plant at Searcy, Arkansas. They desire quotations on new and also second hand machinery for the same.

Cosmopolis, Wash.—The Grays Harbor Commercial Company will add a 200 light dynamo. C. F. White is purchasing agent.

Glenwood, Ia.—The Iowa Institution for Feeble Minded Children may increase the capacity of its plant during the year.

Baldwinsville, Mass.—The Hospital Cottages for Children will add a small dynamo to its equipment. Dr. Flood is purchasing agent.

Minnehaha, Minn.—The Minnesota State Soldiers' Home will make improvements to its plant; just what, is not yet definitely settled.

Washington, Ia.—The Washington Illuminating Company will add a commercial arc light circuit. George T. Lewis is purchasing agent.

Auburn, Ala.—The Alabama Polytechnic Institute will add analternating plant for experimentalpurposes. A. F. McKissick is purchasing agent.

Arlington, N. J.—The Arlington Manufacturing Company will add to its equipment an incandescent dynamo. W. O. Cragg is purchasing agent.

Lebanon, Ky.—The Electric Light & Ice Manufacturing Company contemplates adding an engine and an arc dynamo. J. M. Freber is superintendent.

Daseka, Minn.—Everett Aughenbaugh & Co. will install a larger incandescent dynamo, also purchase a new outfit for its mill at New Richland, Minn.

Albert Lea, Minn.—The Albert Lea Electric Company will increase its dynamo capacity and add an engine and boiler. C. G. Edwards is purchasing agent.

Gruilford, Me.—The Piscataguis Woolen Company contemplates adding another incandescent dynamo, 500 light capacity. J. R Pollock is purchasing agent.

South Keene, N. H.—The Read Furniture Manufacturing Company may increase the capacity of its plant, for street lighting. R. M. Read is purchasing agent.

Montgomery, Ala.--The Mutual Light & Power Company contemplates the addition of a 2,500 light alternating dynamo soon. A. E. Worswick is purchasing agent.

Fredonia, N. Y.—The Dunkirk & Fredonia Railroad Company may install an incandescent lighting plant in the near future. M. M. Fenner is purchasing agent.

Ashaway, R. I.—The Forest Glen Worsted Mill Company will install a 350 light dynamo in place of its present one of 150 light capacity. W. R Wells is purchasing agent.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

Pueblo, Col.—The Pueblo City Railway Company may extend its lines a mile or so soon.

Sanford, Me.—The Mousam River Railroad Company may extend its lines to Kennebunk, in the spring.

Columbus, Ga.—The North Highlands Rail Road Company contemplates an addition of four miles to its lines.

Bloomington, Ill.—The Bloomington City Railway Company will add a new engine, boiler and generator.

Ashland, Ky.—The Ashland & Catlettsburg Street Railway Company contemplates a two mile extension of its lines.

Cairo, Ill.—The Cairo Electric Railway Company have petitioned City Council for the privilege of adding a loop of 4,400 feet.

Vincennes, Ind.—The Vincennes Citizens Street Railway Company may extend its lines. E. F. Turdolph is purchasing agent.

Wakefield, Mass.—The Wakefield & Stoneham Street Railway Company will extend its lines ten to fifteen miles in the spring.

Lexington, Ky.—The Passenger & Belt Railway Company contemplates increasing its equipment. C. H. Stall is purchasing agent.

Michigan City, Ind.—The Lake City Electric Railway Company will change its lines to electric soon. F. H. Root is purchasing agent.

Kansas City, Mo.—The Metropolitan Street Railway Company contemplates a one mile extension of its lines. F. M. Bernardin is purchasing agent.

Lowell, Mass.—The Lowell & Suburban Street Railway Company contemplate an extension of six miles to Billerica Centre and Chelmsford Centre.

Stockton, Cal.—The Stockton Electric R. R. Company will extend its lines to Lodi, twelve miles single track, for both freight and passenger service.

Boston, Mass.--The West End Street Railway Company contemplate making the balance of its road electric in the spring. H. F. Woods is purchasing agent.

Brockton, Mass.—The Brockton Street Railway Company contemplates extending its lines to Houghton & Bridgewater. H. B. Rogers is purchasing agent.

New Bedford.—The Union Street Railway Company will electrically equip the balance of its lines during the coming year. A. P. Smith is purchasing agent.

Quincy, Mass.—The Quincy & Boston Street Railway Company proposes to extend its lines to Braintree and East Weymouth. B. J. Weeks is purchasing agent.

Marion, Ind.—The Queen City Electric Railway Company contemplates an extension of eight miles to its lines, also the erection of a power plant and power house, early in the spring. A. A. Boyd is manager.

Hannibal, Mo.—The Hannibal Railway Company contemplates a two mile extension of its lines. James O'Hern is purchasing agent.

Port Huron, Mich.—The City Electric Railway Company will extend its line two miles in the spring. H. A. Dixon is purchasing agent.

Rockford, Ill.—The West End Street Railway Company contemplates an extension of its lines in the spring, a franchise having been secured.

Charlotte, N. Y.—The Grand View Beach Railroad Company are preparing to build a new brick power house to replace old one recently burned.

Manistee, Mich.—The Manistee, Filer City & East Lake Railway Company will add a few cars and extend its line two miles. Frank J. Huntoon is purchasing agent.

Saginaw, Mich.—The Union Street Railway Company will erect a new power house, re-lay its tracks with new 60 lb. rails and extend its lines. W. J. Hart is purchasing agent.

St. Louis, Mo.—The Midland Street Railway Company contemplates increasing its power plant and an extension of eleven miles to its lines. Geo. Kingsland is purchasing agent.

Bozeman, Mont.--The Gallatin Light & Railway Company may build fifteen miles of line and also develop a water power of 2,000-horse power. H. M. Ogden is purchasing agent.

Jamestown, N. Y.—The Jamestown Street Railway Company contemplate building three miles of additional track. Sixty pound rails will be used. Geo. E. Maltby is purchasing agent.

Mobile, Ala.—The Mobile Light & Railway Company contemplates a two mile extension of its road, the addition of engines, boilers and an alternating dynamo, also improvements at Monroe Park. J. H. Wilson is purchasing agent.

NEW BOOKS.

The Inventions, Researches and Writings of Nikola Tesla. By T. Commerford Martin, 1894, cloth, 500 pages; 330 illustrations and new portrait. Price post paid $4.00.

This book will be greatly appreciated by the thousands who have become interested in the original work done by Tesla. His ability to place before a popular audience the results of his investigations and the willingness with which he has shared his thoughts and his work has won him friends wherever electricity is known. The recent discoveries in the domain of electricity draws the eyes of the public toward the more advanced thinkers and experimenters in this field and the greatest interest is manifest in their work. This volumne is a compilation in an excellent form for preservation of the work which up to the present time Mr. Tesla has made public. A short biographical sketch forms the opening chapter. The first part of the book is given to polyphase currents. To this subject twenty-four chapters are devoted. The experiments with motors, generators, transformers, etc., constructed in different manners are described. Numerous cuts accompany the text, making clear the subject discussed. The second part of the book deals with experiments with currents of high potential and high frequency. The substance of his lectures on this subject are embodied in the matter here given. The accompanying illustrations show the construction of the apparatus used in these experiments and the operation of the apparatus as far as possible. Part three includes the study of a variety of inventions and discoveries made in the older branches of electrical work. This section covers the more practical side of the field. Many interesting results are obtained from these experiments. Part four deals with early phase motors and the Tesla mechanical and electrical oscillator. In the first chapter Mr. Tesla's personal exhibit at the Fair is described and illustrated by views which show the exhibits as there arranged. The volume closes with a description of his mechanical and electrical oscillator. After a study of this work the field of discovery seems to have been immeasurably extended. The possibilities for the inventor in the electrical field are opened up and we cannot but admire the perseverance of the man who has worked out so many difficulties in making subservient to man this wonderful force of nature. The student, the electrician and the popular reader grow enthusiastic as they become interested in the experiments so lucidly described in this book.

FINANCIAL.

February opens with greater confidence in the business world. January which was looked forward to with uncertainty has been safely passed. The country awaits the end of the tariff debate and the bond issue. Until such a time business will be more or less unsettled. Dealers are purchasing larger quantities of supplies. The stock has been drawn upon until it is necessary to replenish and the improved condition of business has warranted the opening of many mills and factories which have been closed. Several banks which suspended last summer have recently opened.

The stock market shows little animation. Electric stocks quoted experienced a slight decline toward the close of the month. The Bell Telephone stock gradually dropped from 190 to 169 through both the intended increase in capital stock from 30 to 50 millions and the expiration of the Bell patent on January 30th. Large blocks of stock were sold at these figures. General Electric sold down to 33¼ influenced undoubtedly by the result of the Buckeye lamp case. Probably the most important moves in the electrical trade is the concentration of the General Electric Company's interests at Schenectady, N. Y. The manufacturing departments are now moved to the shops there. The auditor's office is now established there. The offices in New York, Boston, Chicago, etc., are but sales offices, the entire work of the company being done at Schenectady. This change is a great loss to Lynn. The shops at that place will be practically idle. This new arrangement will undoubtedly be for the best interests of the company from an economic standpoint. The immense office rent of old offices will be practically saved.

But few sales are recorded of the Westinghouse stock. The prices are the same. The Boston News Bureau recently published a statement that the Westinghouse company was doing a business of fully 6 millions per annum, employing 2,000 hands and doing a large business in electric railway equipments. The new shops are under way and when completed will afford unexcelled facilities for the manufacture of all kinds of electrical machines.

The Consolidated Car-Heating Company, of Albany, N. Y., at its meeting on January 9th, declared a regular semi-annual dividend of three per cent payable February 15, 1894. The affairs of the company as reported at the meeting showed a prosperous condition.

The Chicago Edison Company has voted to increase its capital stock from three to five millions.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING Jan. 29
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	169
" " "	Bds. 1893.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co... ...	Com.	14,000,000	100	....	....	85
Commercial Cable Co	Com.	7,716,000	100	....	....	120
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	F. Q.	124
" " " ...	C. Bds. 1898.	71,000	100	6	M. & S.	.....
" " "	C. Bds. 1901.	586,500	100	6	M. & N.	.....
" " Brooklyn..	Com.	2,500,000	100	....	Q. F.	85
" " " ..	1st. 1940.	500,000	100	5	A. & O.	100
" " " ..	Regis.	....	100	5	A. & O.	.....
" " Chicago...	Com.	3,000,000	....	8	Q. F.	.....
" " "		2,500,000	....	....	....	.....
" " New York.	Com.	7,9 8,000	100	....	Q. F.	97
" " "	1st 1910.	2,562,000	100	5	M. & S.	104⅛
" " Phila......	Com.	1,473,000	100	....	....	120½
" " "		....	....	5	....	.....
Fort Wayne Elec. Co...... ...	Com.	4,000,000	25	....	....	4½
General Electric Company.	Com.	30,457,000	100	....	......	33¼
" "	Prf'd.	4,251,900	100	....	....	65
" "	Deb. 1922.	10,000,000	100	5	J.-D.	70
Gold & Stock Tel. Co............	Com.	5,000,000	100	....	Q. J.	....
Northwestern Gen. Elec. Co.....	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	750,000	100	....	J. Q.	.....
Thomson Elec. Weld'ng Co......	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	..	....	.....
Thomson-Houston Elec. Co . .	Series D.	1 0,000	10	....	....	5⅜
Thom'n-Houst'n Intern. Elec. Co.	Com.	600,000	100	..	....	.....
" " " "	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co....	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q. J.	81¼
" "	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	26
" " "	1st Pf. Cum.	3,755,700	50	7	....	46
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R..............	Com.	6,000,000	10	....	Q.-J.	170
" "	1st Bds. 1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	....	Oct. 1.	.....
" " " ..	1st Bds. 1909	300,000	100	5	J. & J.	.....
" " " ..	Certf. 1894.	300,000	100	6	J. & J.	.....
BUFFALO—						
Buffalo St. Railway.............	Com.	5,370,500	100	5	....	.....
" "	Bds. 1931.	5,000,000	100	....	F. & A.	.....
BOSTON—						
West End St. Railway..........	Com.	9,085,000	50	..	J. & J.	58
" "	P. f'd.	6,400,000	50	5	J. & J.	80
" "	Bds. 1902.	3,000,000	100	....	M. & N.	.....
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	.....
" "	Prf'd.	1,000,000	100	5	A. & O.	.....
" "	1st Bds. 1930	6,000,000	100	....	J. & J.	.....
NEWARK, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	....	....	27⅜
" "	Bds. 1930.	6,000,000	100	5	J. & J.	84½
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	155
" "	Bds.	2,000,000	100	....	....	.....
PITTSBURGH—						
Duquesne Traction Co....... ...	Com.	3,000,000	50	...	....	22
" "	Bds. 1930.	1,500,000	100	5	J. & J.	102
Fed. St. & Pleas. Val. R. R......	Com.	1,400,000	50	....	J. & J.	17¾
" " " " "	Bds. 1919.	1,250,000	100	5	J. & J.	100
Pittsb'gh, Aleg. & Man. R. R....	Com.	3,000,000	50	....		38
" " "	Bds. 1931.	1,500,000	100	5	J. & J.	100
Pittsburgh & Birming. R. R.....	Com.	3,000,000	25	....	....	13
" " "	Bds. 1929.	1,500,000	100	5	M. & N.	98
ROCHESTER—						
Rochester Railway Company....	Com.	5,000,000	100	...	....	67
" " "	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway.............	Com.	2,500,000	100	....	Q.-J.	72½
" "	Bds. 1910.	1,500,000	100	5	J. & J.	100
St. Louis & Suburban...........	Com.	2,500,000	400	....	....	30
Union Depot Railway...........	Com.	1,200,000	100	....	....	.....
" " "	Bds. 1910.	1,000,000	100	6	A. & O.	100

TRADE PUBLICATIONS.

"Ten to None" is the title of a little circular which Mr. George Cutter of Chicago has been sending out. Ten points of merit to none of demerit indicating the desirability of Cutter's street hoods for street lighting It is nicely printed, attractive in make up and sets forth the features of the articles in an excellent manner.

Circular and price list No. 3 from the Weston Electrical Instrument Co. of Newark, N.J., gives descriptions and prices of portable direct reading voltmeter for director alternating current work. The excellent character of the instruments is in many ways pointed out. The double scale instruments and the high range voltmeters with multipliers are listed and recommended for the laboratory and other places in which instruments of like capacity and accuracy are required.

Catalogue No. 3 for 1894 issued by the R. Thomas & Sons Co., of East Liverpool, Ohio, is gotten up in very attractive style and shows to advantage the extensive line of goods manufactured by the company. Porcelain in every shape required in the numerous specialties used in electrical installations, in the telephone, telegraph and electric light service are shown in the catalogue. It announces extensive additions to the works which will insure not only the prompt filling of orders but the best grade of work.

The five styles and one hundred sizes in which the Stanwood steel step is made are neatly illustrated and described in the catalogue just issued by the Stanwood M'f'g Company, of Chicago. Clear type, wide margins and heavy glazed paper help to make the catalogue attractive. The cuts show the detail of the steps and the remarkable perfection to which the construction of these steps have attained. Attention is called to the recent improvements in the steps, of which the pressed steel hangers and the new shapes of the step are noticeable.

About a year ago the Joseph Dixon Crucible Co. of Jersey City issued a pamphlet on lubricating graphite. It embodied an elaborate scientific opinion by Prof. R. H. Thurston on the value of graphite as a lubricant, and much interesting information on the subject from practical men. The pamphlet has had a large circulation, and the company has been enabled to obtain from well-known men a vast amount of additional knowledge on the uses of graphite. Another pamphlet, twice the size of the former, will be issued early in February, and a copy will be sent free of charge to all interested in the subject of friction and lubrication.

A pamphlet containing much interesting information regarding secondary batteries has been issued by the American Storage Battery Co., Chicago. The abstracts from articles on the use of secondary batteries, showing the value of the battery for many purposes and the results of the practical use of the batteries as regards cost, efficiency, convenience and durability are of the right kind to interest the prospective user. The cost of train lighting is given very specifically, both the cost of the installation, per train and per light, and the cost of operating. The many advantages of the secondary battery for isolated lighting are also explained.

The Lundell dynamos and motors are presented in a very fine manner in the catalogue just issued by the Interior Conduit & Insulation Co., of New York. The cuts that are distributed through the pages are very clear and show accurately the different parts of the machines. The advantages of the iron-clad construction, the use of but one field coil and the peculiar form of pole pieces, which are noticeable features of the Lundell dynamo, are set forth in the reading matter. A table showing the efficiency of the different sizes of machines is also included in the contents to which is appended directions for setting up and operating the motors and dynamos, and a number of plates showing the electrical equipments of yachts and steamships in which the Lundell dynamos are used.

Points on Perforated Electric Belting is the title of a very neatly gotten up pamphlet just issued by Chas. A. Schieren & Co. It contains much interesting matter on belting together with numerous half-tone engravings of extra large belts shipped to various electric companies throughout the United States, and also of the immense 96-inch electric belt 200 feet long on car as it was shipped to the World's Fair. The process of manufacturing the perforated leather belting is described, and many pointers are given on the care of belts and the methods of measuring for and of putting on belts. A list is given of the prominent railways using the perforated electric belts. Price list of belts, belt clamps, belt dressing and cement, and leather cord for street cars are also included in the pamphlet.

PERSONAL.

Mr. E. J. Cook, manager of the engine department of the Field Engineering Co. of New York, called upon Electrical Industries last month.

Mr. W. H. Preece, F. R. S., has received recognition of his achievements in the shape of honors conferred by the Queen, having been made Companion of the Bath on New Year's day.

Mr. Chas. G. Burton, Chicago, has accepted the position as manager of the motor and interior conduit departments of the Central Electric Company. Mr. Burton has had many years of practical experience in the line of installing plants, wiring, etc., which well qualifies him for his new position.

Mr. Carl Kammeyer has recently accepted the position of western manager of the Electrical Engineer. Mr. Kammeyer has been for a number of years actively connected with the electrical industry, and has many friends and acquaintances in the trade who will wish him success in his new position.

Mr. Jas. B. Olson is the western selling agent for the New York Insulated Wire Company and has charge of the Chicago office of the company. He is actively engaged in pushing the sales of his well-known wire and is meeting with good success, having just returned from a successful trip in the East.

Mr. E. E. Keller, who has had the management of the Westinghouse Electric & Mfg. Co.'s affairs at the World's Fair, has been elected vice-president and general manager of the Westinghouse Machine Co. Mr. Keller will divide his time between Pittsburgh and Chicago until the World's Fair plant is removed. Mr. Keller's many friends wish him success in his new position.

BUSINESS NOTES.

Horne & Martin, 505 Home Insurance Building, Chicago, are the general agents of the new National Electric Co., of Eau Claire, Wis.

The Jones Bros. Electric Co., of Cincinnati, O., reports a recent contract for 50 miles of trolley wire from the Cincinnati Street Ry. Co., also a generous number of orders for electric station and railway supplies.

Mr. James F. Kelley has opened an office at 5 and 7 Beekman St., New York, for the sale of apparatus from the National Electric Works at Eau Claire, Wis.

The Globe Light & Heat Co., Chicago, report a much increased business since the first of the year in the electric and combination fixtures it manufactures.

The Groton & Knight Mfg. Co., Worcester, Mass., has opened a western branch at 173 So. Canal St., Chicago. Mr. Joseph Kendall is general manager of the new office.

Texas Electric Brokerage Co., Dallas, Tex., is the name of a company recently organized for the purpose of conducting a business of electrical broker and manufacturers' agent.

The Central Electric Company, Chicago, has equipped itself for the furnishing of a complete telephone set which they are now prepared to sell outright to anyone that desires.

The Complete Electric Construction Co., New York, has established a western office at 1401 Monadnock Block, Chicago, with Mr. Clift Wise, one of the oldest and best known street railway engineers in the country, as western manager.

Mr. George W. Furbeck has opened an office at 1161 Monadnock Block, Chicago, as a contractor for all kinds of electrical construction. Mr. Furbeck is at present installing a $25,000 plant for the West Chicago Street Railway Tunnel Company.

The Mason Electric Company, Pullman Bldg., Chicago, has just been incorporated. The manager of the new company is Mr. W. R. Mason, formerly the president and manager of the Railway Equipment Company. The company will deal in electric railway supplies.

The Stilwell-Bierce & Smith-Vaile Co., of Dayton, O., suffered a considerable loss by fire to its Chicago stock on the 29th of last month. We understand, however, that the Chicago business is not inconvenienced by such a small affair as a fire and that everything is moving on as ever.

The Electrical Engineering Company, Minneapolis, Minn., is out with a new discount sheet, in which it announces a discount in prices equal to those in the East. This fact, taken with the fact that it can make shipments promptly from stock, should bring the company its share of the trade.

The Western Telephone Construction Co., 440 Monadnock, Chicago, has already made a considerable stir in telephone circles. The experience of the men at the head of the company together with the facilities of the company to undertake and carry out contracts for the installations of telephone systems characterizes them as one of the most progressive companies of the west.

Messrs. Sargent & Lundy, Chicago, have moved their offices from the 14th floor of the Monadnock Block to the ground floor where they have very fine quarters fitted up. A liberal amount of show room is secured for the display of the electrical and power machines for which Messrs. Sargent & Lundy are western agents.

Shultz Belting Co., St. Louis, Mo., has just received an order from England for two thousand eight hundred feet of Shultz leather belting and an order from Russia for fifteen thousand feet of leather belting. Such orders speak well for the Shultz belt. The company reports trade as looking up and the orders now coming in indicate a fair business for the spring.

The Perkins Electric Switch Mfg. Co., Hartford, Conn., has opened a western branch in Chicago with Mr. G. W. Conover, formerly with the Ansonia Electric Co., as manager. The western office of the company is in the Monadnock Block, room 1536, where Mr. Conover will see his old friends and make many new ones.

The Phenix Glass Co. has added much to the attractiveness of its Chicago salesroom by hanging in it many of the fancy shades and globes from its World's Fair exhibit. Mr. E. H. Fox says business is good, but is prepared with a large stock which contains many new and attractive designs of glassware for brackets, electroliers and drops, for a much larger trade.

T. J. Murphy & Co., 136 Liberty street, New York, will conduct the business formerly carried on by T. J. Murphy. Mr. Murphy has formed a partnership with Mr. J. F. McGuire, who brings both experience and capital, thus increasing the ability of the firm. A larger stock of marble and slate suitable for switchboards will be carried, and the facilities for manufacture will be increased.

The Central Electric Co., 118 Franklin street, Chicago, reports the receipt of a large stock of Gale's commutator preserver, which has been used so extensively by central stations during the past five years. The Central people state that they know of nothing that has been so largely used or that would replace it. The success attending its use has created a steady and increasing demand for it.

The Chas. E. Gregory Company, 47 and 49 South Jefferson St., Chicago, the well-known dealers in second-hand lighting apparatus of all kinds, reports an unusually active trade. The past month's business was one of the best in the history of the company. In fact, Mr. Chas. E. Gregory, the president of the company, states that his facilities are taxed to the utmost to fill orders and make shipments promptly.

The Royal Arc Electric Co., 143 Liberty street, New York, has received great encouragement in the introduction of its arc lamp, the Howard incandescent arc device, having been indorsed by the Hartford board of fire underwriters. The rules of the board do not permit the use of arc lights in buildings without spark arresters, and the above device is a perfect spark arrester, and has been adopted by a large number of business houses.

Cushing & Morse, 225 Dearborn street, Chicago, the general western agents for Kerite insulated wire and cable, are calling special attention to the pen that is mightier than the sword. The penholder which has been distributed among their many friends and customers is of aluminum, and bears on the feather end the words "Be sure and specify Kerite," and is accompanied by a sample of Kerite insulated wire.

W. L. Adams & Company, Chicago, report an increase in the amount of business done during the past few weeks, and that the outlook for future business is good. Mr. Adams returned recently from a trip in the east, and while away secured some good orders. This firm has the western agency for the Medbery overhead wire line material and will carry a complete stock. The Climax track cleaner which the firm is pushing the sales of has met with an extensive sale.

The Sunbeam Lamp Manufacturing Co., Chicago, is the new name of the Star Electric Lamp Co., the manufacturer of the Sunbeam lamp. Experiments have been conducted for some time on the incandescent lamp by the company, which have resulted in important discoveries. These discoveries have been embodied in the lamp, and it is said that the lamp is greatly improved in quality. It is the policy of the company to furnish a superior quality of lamps.

Pullman's Palace Car Company has just received an order from the Electric Traction Company of Philadelphia for forty closed cars. The cars are to be finished in cherry, with oak veneer ceiling, carpet covering for seats and tasty decorations. The cars are to be mounted on McGuire's Columbian trucks. An order from the Citizens' Street Railway Company of Memphis calls for eight ten-seat open cars for early delivery. The company reports that the indications point to greater activity in the street railway field.

Queen & Co., Inc., Philadelphia, makes a special form of electrodynameter which has been supplied largely to central stations and manufacturing concerns, for use as a standard ammeter in measuring both direct and alternating currents. The fact that instruments built upon this plan are capable of very exact calibration which does not change, renders them reliable and efficient. A line of standard voltmeters on the hot wire plan, made under the Cardew and other patents, is to be brought out by the company. Experiments have been con ducted in the laboratory for some months on the new instruments.

The Chicago Rawhide Manufacturing Company, Chicago, the well-known manufacturers of rawhide dynamo belting and other goods, is running as usual on full time and with full force in factory. The company is to be congratulated upon the fact of its having been one of the few manufacturing concerns in the country that have all through the depression run on full time and during part of the time overtime. The company reports the outlook for increased business very excellent indeed.

The Western Electric Company has been awarded the contract for furnishing the arc machines to the new city plant at Detroit, Mich., now under construction. This is one of the largest contracts that has been given for a long time, and the company deserves great credit for having secured the order. It is understood that the company will furnish a new 100-light machine of a new pattern. The company is at present running on full time with a full force. The company reports that it is now doing as much business as in 1892.

Messrs Gray & Clark, of the New England Pottery Company of East Boston, Mass., have perfected a porous cell which has just been placed on the market. The cell is so constructed that it withstands the handling it is subjected to in packing and shipping and a larger percentage reach the consumer. The percentage of loss in handling the old style cell has been very great, and in the new cell, which is in part brought out as the result of the fifteen years of experience which its designers have had, the saving in that direction is put in the construction of the cell. This cell, with its reinforced top, will undoubtedly be greatly appreciated by the trade.

The Consolidated Car-Heating Co., Albany, N. Y., has received a second order from England for direct steam storage heating equipments. These equipments are so arranged that the temperature in each compartment can be separately regulated. The C., C., C. & St. L., otherwise known as the "Big Four," the Lehigh Valley, the New York, Ontario & Western, the Fall Brook, the Connecticut River and the Boston & Albany railroads have recently abandoned all other patterns of steam couplers and have made the Sewall coupler their standard. The Consolidated Car-Heating Co. has sold over 10,000 Sewall couplers since the beginning of the present heating season.

The Electric Appliance Co., 242 Madison St., Chicago, has just received several large consignments of line material that has been placed in stock. To arrange these consignments in the warerooms has required a considerable force. The increased number of orders received when immediate shipments can be made has convinced the company that a large and varied stock is a paying investment. The Washington alternating arc lamp has received a number of improvements among which are the shortening of the lamp several inches, effected by doing away with the metal base, and the polished metal shade, by the use of which a larger percentage of the light is utilized.

The Great Western Mfg. Co., 205 So. Canal St., Chicago, shipped last week the electric lighting apparatus for the Fremont Elec., Light & Power Co., of Cripple Creek, Colo., and also received an order from the company's Colorado agent for an electric lighting plant for Leadville, Colo. The company is making a specialty of electrical mining apparatus and has furnished a number of equipments for Mexico where it is nearly always necessary to transport the machinery by mules which requires it to be put in packs not exceeding 300 pounds. The company has met with success in the sale of the Clark wire and now offers the Howard lamp in competition with the Edison prices.

Chas. A. Schieren & Company, at their Chicago branch, 46 S. Canal St., have just completed one of the finest belt stores in the city and claim to carry the most complete stock of belting in the west, being able to supply from stock any size belt up to 48 inches in width. The size of the new store is 50 feet by 150 feet. Everything is arranged for convenience, the offices being located in the front of the store and comprising the office of the manager, bookkeeper, stenographer, etc. Mr. E. L. Burrell is the manager of this branch of the company's business and since taking charge has, by means of his enterprise and energy, built up within the past few years a very large business throughout the west.

The Keystone Electric Co., Erie, Pa., has moved into its new quarters on 12th St., a very substantial two-story brick building 100 by 50 feet, with an addition of 30 by 40 feet, in which the dynamo and testing departments are located. The offices of the company are pleasantly situated on the second floor, near which is the draughting department. The main machine shop on the ground floor is fully equipped with modern machinery which will enable the company to turn out any size of dynamo or motor up to 100 K. W. During the recent dull times and up to date the shop has been running on full time with the full number of men. A new design of machine has been placed on the market, of the four pole type, of which the company is now building an 80-horse power generator and a 60-horse power motor, and have orders also for several more.

Taylor, Dee & Mack, 348 Dearborn St., Chicago, report business as improving. This firm carries a complete stock of electrical goods and extends an invitation to all purchasers to visit them, look at the different lines they are handling and test their facilities for furnishing almost anything in the electric line promptly at lowest prices. With over eight years experience in the electrical supply business, and sole Chicago agents for some of the largest and best factories in the country it would seem that purchasers could place their orders with them with the assurance that they will be handled in an entirely satisfactory manner. During the last month this firm installed three complete isolated plants including steam engines and fittings, also several large sized motors for running elevators and other purposes. The supply business they state is growing daily.

Wm. Baragwanath & Son, Chicago, manufacturers of feed water heaters and purifiers are running full time, having a good number of orders on hand to fill. Among the shipments made during January are the following: One 500-horse power combined heater and purifyer for the new New York Life Insurance Building, Chicago; one 800 horse power heater for the new Stock Exchange Building, Chicago, a 300-horse power heater for the Metropolitan Electric Railway of Springfield, Mo.; a 500 horse power heater for the new Planters' Hotel, St. Louis; a 500-horse power heater for the new St. Nicholas Hotel. St. Louis; an 800-horse power heater for the Union Car Co., Buffalo, N. Y.; also a 300-horse power heater for shipment to Montana. The firm is especially fortunate in having a large amount of work on hand, and the prospects for good business in the future is reported as excellent.

The Metropolitan Electric Co., 186-188 Fifth Ave., Chicago, has been arranging a large line of staple goods in the new warehouse. The large stock of N. I. R. wire received and Metropolitan lamps has enabled the large number of orders received for these goods to be promptly shipped. The increasing business of the company has required the increase in the official staff and an efficient member has been secured in Mr. J. J. Nate, for many years purchasing and supply agent of the Chicago Telephone Co. The handling of telephone supplies will soon be an important line of the trade, in which Mr. Nate's experience will be especially valuable. The line of standard supplies and specialties has been constantly increasing. The N. I. R. factory now manufacture electrolier wire, lamp cord, rubber and friction tape making the line of electrical conductors and insulations complete.

The General Electric Company has secured a large slice of the street railway car equipment contracts awarded during the last ten days in Philadelphia. Of 250 contracted for by the People's Traction Company, 125 of the G. E. 800 motors and type K. controllers were purchased from the General Electric Company, while the remaining 125 were allotted to the Sperry Company, of Cleveland. Of 80 equipments required by the Electric Traction Company, of Philadelphia, 70 will be furnished by the General Electric Company. The People's Traction Company had already contracted for three of the great 1,500 K W. General Electric generators. The General Electric Co. has also secured contracts during the past week, covering 20 car equipments for the Union R. R. of New York; 25 car equipments for the Steinway R. R. of Long Island; 1,700-horse power generator for the Steinway R. R., of Long Island; 1 M. P. 300 K W. generator for Cincinnati.

The General Manufacturing Company has recently been formed in New Jersey. The capital is $2,500,000. The offices of the company are at number 911 Havermeyer Bldg., Church and Cortlandt Sts., New York. The officers are Auner W. Pollard, president; Robert S. O'Loughlin, vice-pres.; Louis A. Pollard, treasurer; Godfred G. Kidder secretary; and J. B. Cleaver, business manager. The manufacture of graphite bearing, wheels and axles, pulleys and hangers, etc., will be one department. Foundry, machine shop and boiler shop will be another department, where particular attention will be given to the manufacture of water works plant and hydraulic engineering generally. The full high pressure system as introduced by Ernest W. Naylor, into this country will be made a specialty. Mr. Naylor undertaking the superintendance of this department other manufactures will be added as may be deemed advisable. Works will be built at Bound Brook, N. J., as speedily as possible.

Mr. J. L. Barclay has moved into his new business quarters on the 16th floor, in the south end of the Monadnock Block, the now recognized center of electric trade in Chicago. The suite of offices selected are well adapted for Mr. Barclay's electrical interests, and primarily selected by him for exploiting the Walker Manufacturing Company's electric railway and power transmitting business. The central and western departments of that company's business is under Mr. Barclay's immediate supervision and management. Mr. H. McL. Harding, who is also interested in the above company, has his headquarters for the eastern department in New York. While the general electrical interests of the Walker Manufacturing Company will receive the combined attention of Messrs. Barclay and Harding, all business directly connected with the western and middle states will be transacted at the Chicago headquarters. The appointment of district and sales agents is now receiving attention. At this time, particularly, little trouble will be encountered in securing competent men. Mr. Barclay feels very much encouraged at the business outlook, notwithstanding the financial depression, inquiry for the heavy types of generators and motors, such as the Walker company manufacture, being numerous. A description of these machines will be published in a short time together with cuts showing the general design of the machines.

ELECTRICAL INDUSTRIES.

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Report of the National Electric Light Association Convention.

The seventeenth convention of the National Electric Light Association was called to order in Grand Army Hall, Washington, D. C., Tuesday morning, February 27th, and the following address delivered by the president, Mr. E. A. Armstrong:

*Fellow representatives to the National Electric Light Association. Ladies and Gentlemen:—In opening the session of the seventeenth convention of this association, I might be counted remiss did I fail to congratulate you specifically as well as generally. And I find myself constrained to preface it with a note of regret. It was my hope and purpose to have this session held in Philadelphia, where, being at home, we could have an enjoyment, in some degree commensurate with our past experiences of those social attentions and attractions which have made our sessions famous. But in the midst of all our pleasurable experiences of the past in this line, there has been running continually the admonition that this must be ended, but from Providence we had Montreal; Montreal we had Buffalo; Buffalo we had St. Louis; and indeed it seemed as if perfection was being perfected. With this in view then your executive committee with practical unanimity overruled my Philadelphia suggestion when I made it and those present as well as the absent ones who communicated with us, fixed upon this beautiful city, which while it was no man's city, was nevertheless everybodys.

The past year has been a very trying one on electrical enterprises. As we are among the settled businesses of the country the newest, and therefore the most elastic, we have felt the financial stringency, the oppression of the times, worse than many others, but we have not been without cheer and encouragement during it all. If my figures are correct, and I have tried to obtain them from the most reliable source, there are now upwards of 2,300 central stations in this country, representing at least $200,000,000 of capital. Involved in electrical manufactures and supplies of various kinds, are as many millions more; this, employing as it naturally does, hundreds of thousands of men; supporting hundreds of thousands of homes; adding to the material wealth, prosperities and happiness of our people, makes us as representatives, trustees of a great and responsible trust. This is a growth practically of the last decade. He would be a brave man indeed, who would dare even to suggest the limit of the possibilities of the use of electricity for great and important works. Night has been turned into day and the industry of man is applied for the full twenty-four hours of time, and the days therefor, are multiplied by just that much; distance is annihilated so that last summer, I, while being a thousand miles away, enjoying the beauties of that wonderful White City and drinking in the lessons there taught, was still within speaking distance of my office.

These wonders and marvels, for wonders and marvels they are, are only valuable in so far as they add to the comfort and happiness of the world; that they do, none of us will deny, and therefore as I call your attention to the business that has brought us here together, do not accuse me of making use of hyperbole, when I say to you, that you do not meet merely as representatives of business enterprises, merely as representatives of so many millions of dollars. invested in dividend producing concerns, but as the representative of an industry, a science that means benefit to the race, that means more health, more happiness, more encouragement, more comfort to fellow man. In the highest, truest, best sense we are representative benefactors.

The history of the past year has not been varied, except for the rocks and difficulties to which I referred, from the history of those that have preceded us. There has been a tendency in the last few months, however, for a revival, largely instigated by, I am afraid we will have to say, by the representatives of our large manufacturing corporations of the agitation of municipal ownership of electrical light plants. I sincerely believe that to be a bad policy for the city, as I have always maintained. I believe it to be a worst policy for the manufacturing concerns that advocate it. But no city can ever afford to do an unfair thing.

I trust and believe upon the character of the papers to be read, and from the other matters provided on our programme as well as from the large and interesting attendance, that we will have the most profitable session which we have yet enjoyed, as an Association. I proceed with the duties of my office here, not bringing to it the technical knowledge possessed by my predecessors, I ask your patience and indulgence and bespeak your friendly forbearance, promising to deal as intelligently as I possibly can, with the legal and business aspects of electrical light and power, in calling upon those associated with us, who are competent to speak. As to the rest of our business, I shall call your attention to our programme. I now declare this convention formally opened.

MEMBERS OF THE SEVENTEENTH CONVENTION, NATIONAL ELECTRIC LIGHT ASSOCIATION.

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*Abstract of address.

Mr. C. H. Wilmeding, of Chicago, chairman of the Committee on Legislation, made the following report: "I regret that this committee has no formal report to make. Since my appointment as chairman of the committee no important information has reached us in regard to legislation effecting electric light interests. However, there has been a great deal of that sort of legislation threatened, but I am not in a position to speak about it, as different members of the committee, in the different States, have not reported to me as chairman; and I would suggest that if any of the members of the committee are present that they be asked to make some remarks in regard to legislation affecting our interests in their particular States."

The president announced the next report in order to be that of the Committee on Finance. Mr. John A. Seely, the chairman read the report, which showed the finances to be in satisfactory condition. On motion the report was accepted and ordered to be filed.

The next order of business was the report of the Committee on "Relation between Manufacturing and Central Station Companies," Mr. Frederick Nicholls, of Toronto, Chairman.

Mr. Nicholls said: "The question of the relation between manufacturing and central station companies, is, as we are all aware, an important one, and one that is to be approached with a great deal of consideration. My official report as chairman of the committee, is simply that the situation is the same. I hope, sir, that we will have an opportunity in executive session of discussing a great many questions which will have to be discussed at far greater length than will be possible to embody in an ordinary committee report."

Dr. Richard J. Gatling, the inventor of the Gatling gun, was here introduced and addressed the convention in a very pleasing manner.

TUESDAY AFTERNOON SESSION.

The president announced the first business of the afternoon session to be the report of the Committee on Data*. Mr. H. M. Swetland, of New York, chairman, read the report as follows:

MR. PRESIDENT: It is somewhat unfortunate that it is the duty of this committee to procure and report facts instead of fancies. We listen here to many fine economies and ingenious methods of saving, and if we could report what a given installation ought to do theoretically, instead of what it does do practically, we could render a report more in keeping with the progressive spirit of these meetings.

We are requested, however, to furnish this convention with the facts regarding the amount of coal used in actual practice to produce a given quantity of electricity. The information was obtained by correspondence, and furnished the committee in amperes, volts, and hours on each circuit, and the amount of coal used covering this period, including that used for banking fires, etc. The aggregate electrical output for twenty four hours was then calculated and compared with the total amount of fuel used, giving the watt-hours per pound of coal. All improbable and apparently erroneous reports were discarded, and the tabulated statement herewith comprises intelligent replies from a large number of the electric stations, including many of the leading corporations. The great saving in operating in large units and running continuously is plainly shown by the report which shows 208 watt-hours per pound of hard screenings where about 8,000,000 watts were generated, running full twenty-four hours, as against the report which claims only 30 watt-hours per pound of soft coal, the total output being less than 60,000 watts and the service being furnished only seven hours. The best reports do not compare favorably with the results secured in generating power for manufacturing purposes.

In order to facilitate this comparison, we have prepared a table based on 90 per cent mechanical efficiency in the engine and the same efficiency in the dynamo:

Then $\frac{746 \times .90 \times 90}{\text{coal per hour}}$ = Watt-power per pound of coal. And

COAL PER HOUR PER 1 H.P.	WATT HOURS PER LB. OF COAL.
1.5 lbs. should produce	402.84
2 " "	302.13
3 " "	201.42
4 " "	151.06
5 " "	120.85
6 " "	100.71
7 " "	86.32
8 " "	75.53
9 " "	67.14
10 " "	60.43
11 " "	54.93
12 " "	50.35
15 " "	40.28
18 " "	33.57
20 " "	30.22

From this estimate of engine and dynamo loss 1½ pounds of coal should produce 402.24 watt-hours. We have a report from the Chelsea Jute Mills of Brooklyn, N. Y., covering a period of six days, where an average of 653.3 indicated horse power was developed from a coal consumption of 1.482 pounds per indicated horse power per hour, the load varying from 495.21 to 764.96 horse power.

This equipment consists of Corlis compound condensing engines and vertical tubular boilers. The plant was in operation 10 hours each day. The figures given cover the whole amount of fuel used, including banking, etc. The fuel used was George's Creek bituminous coal.

TABULATRD STATEMENT OF DATA.

(Where there are blanks in the table, details were not given.)

Hours.	Amperes.	Volts.	Watt-hours.	Pounds Coal.	Kind.	Watt-hrs. per lb Coal.
24	583	115	1,609,070	10,800	slack	150
15½	101	120	187,860	2,940	—	64
14	—	—	386,386	3,755	slack	103
—	—	—	10,989,870	64,155	slack	171
6	25 inc.	1,000	312,000	4,200	—	72
	18 arc.	1,500				
6	800 inc.	52	361,800	8,000	slack	46
	6.8	2,750				
9½	200	1,100	2,090,000	39,750	Ind. block	53
24	10	117	259,600	16,420	" "	166
22	879½	1,180				
7	4½	2,000	59,500	2,000	soft	30
10	225	110	247,500	4,400	slack	56
14½	30	1,046	381,023	7,300	soft	52
7	6.8	1,632				
6	7	2,640	110,880	1,000	pea	110
14.6	—	—	315,360	6,930	slack	46
6.5	—	—	401,249	5,469	"	73
24	39	1,050	982,800	30,852	slack	42
8⅔	9.6	2,068	172,058			
24	296	500	355,200			
15	150	120	210,000	5,925	"	46
13	400	113	587,600	7,000	Pekay	95
10	10	810	81,000			
6	300	120	279,000	4,000	—	70
	10	1,050				
8	19	1,000	152,000	1,404	slack	108
8	113½	110	99,550	1,584	—	79
7	6½	560	26,460			
24	4,409	122.1	12,920,136	70,352	screenings	183
inc. 24	84	1,100	2,217,600	38,220	hard sc'gs	208
arc. 24	80	2,000	3,840,000			
pwr. 24	145	550	1,914,000			
—	200 inc.	125	375,000	7,942	Cumberland and sc'gs	106
	24 arc.	1,550	421,600			
	— pwr.	—	46,000			
15	234	50	189,100	6,000	—	31½
4	6.8	500				
7	285	54½	283,820	3,450	Ptbg. nut and slack	52
12⅔	268	52				
inc. 24	309	110	974,160	12,267	soft	186
pwr. 18	80	500	586,740			
arc. —	—	—	720,000			
6	200 inc.	110 inc.	132,000	2,000	bit. slack	67
	10 arc.	50 arc.	3,000			
6	141	108	91,368	1,400	Lehigh pea	65
14½	26	1,000	377,000	4,200	buckwheat	90
15 inc.	108	1,135	1,838,700	18,600	—	132
18 power	65	525	614,250			
15	60	1,100	990,000	8,960	ant. bkwt.	110
inc. 11	20	1,000	272,250	3,257	Ygy lump	83
arc. 5½	9½	1,000				
12	28	1,000	336,000	3,500	Pardee soft	96
inc. 13	400	52	552,550	6,000	ant bkwt.	92
arc. 11	9½	2,700				
16	46	1,070	787,520	6,500	bituminous	121
pwr. 12	160	203	389,760	27,366	Y'ghiogheny	104
inc. 24	775	132	2,455,200			
inc. 8	240	110	211,200	3,000	bituminous	98
arc 7	8½	1,375	81,812			
inc 15½	230	104	370,760	3,360	slack and nut	111
arc 6	8	45	2,160			
inc. 15½	15	52	12,090	6,100	bituminous	88
arc 13	10	4,050	526,500			
inc. 14½	20	1,000	290,000	6,048	buckwheat	126
arc 14	10	3,400	476,000			
15	1,600	52	1,248 000	6 500	buckwheat	192
24	373	112	1,002,624	8,190	Pittsburgh	122
14	22⅓	1,000	312,666	2,880	Leh V. pea	109
7½	310	115	267,375	3,600	bituminous	76
inc 6½	156	120	121 680	1,681	Cumberland	85
arc. 6	30	120	21 600			
inc. 24	500	112	1,344 000	16,000	hard rice	152
arc. 8	100	9 6	7,680			
pwr 24	200	225	1,080 000			
16.3	33 56	1,000	547,028	4,805	buckwheat	114
inc 12	25	1,000	300 000	4,800	bituminous	71
arc. 5	8½	1 000	42,500			
inc. 15	26	1,000	390 000	7,380	. slack	68
arc. 7	350	45	110,250			
inc. 7	180	110	138 600	6,760	Sidney	46
arc. 12	9.5	2,700	307 800			
inc. 18	30	1,100	594,000	4 300	buckwheat	170
arc. 12	6½	1,800	140,400			
6½	122	110	87,230	1,400	bit. slack	62
8	inc. 19.25	1,100	284 600	2,000	pea	143
	arc. 9.6	1,500				
25	1,200	125	3,750,000	55,420	soft coal	68
10	220	112	246,400	2,100	coal	117
10	217.7	113	246,001	5,320	lump	46
6	inc. 22	1,060	201,120	1,800	—	112
	arc. 6.8	1,500				
5	130	112	72,800	1,800	slack	40
9	120	125	135 000	2,400	bituminous	56
10.46	—		1,180 306	16,053	good lignite	73
14	200	110	308,000	12,000	slack	40
11	10	1,500	165,000			
11	20	1,100	242,000	3 200	McAl. lump.	76
7⅓	203	115	171,197	3,640	Iowa slack	47
14	inc. 30½	1,000	501,256	7,500	buckwheat	67
	arc. 52	102				
inc. 7½	14	54	5,670	3,200	coal	25
arc. 7½	10	1,000	75,000			

Average watt-hours per pound coal 91.7

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*H. M. Swetland, T. Carpenter Smith, E. F. Peck, G. G. H. Blaxter and C. E. cott, Committee on Data.

If our percentage of efficiency is correct, and if we could have a fairly uniform electrical output, this plant ought to produce over 400 watt-hours, or double that of the most favorable report given us, more than double that of the next best report, thirteen times the efficiency of the plant making the lowest report, and between four and five times the average efficiency of the whole report.

No attempt has been made in this report to classify equipments, as was originally intended, but with the information here furnished as a basis, the work can be readily classified, additional information secured, and the original scheme of establishing an average basis of efficiency for the several lines of equipment can be carried out.

The correspondence shows a marked interest in the work and many returns were accompanied by a request for information showing how their report compared with others. We believe the tendency of the work is to encourage more careful records, which in turn assist in locating and eliminating losses, and we hope future reports by this Committee will show a much better average than 88.4 watt-hours for one pound of coal.

Mr. Swetland: "I would like to say that it is the belief of the committee that we did not secure reports from the best stations, and that this average might have been lowered materially if we could have secured reports from stations showing better returns. If I may be allowed to suggest I should like to see the Committee on Data divided geographically and about one hundred reports from the leading stations in all parts of the country tabulated for our next meeting. I think this could be done if some one man would make it his business to see what were the results in New York and another in Chicago, and make a personal investigation of this work instead of leaving it for correspondence. I think we could make a more favorable showing in this way."

The President: "This report is before you. It is a report of facts and figures."

Mr. Swetland: "I would like to call attention to one point, and that is the apparent inaccuracies in a great many of the returns. Out of two thousand enquiries sent out we received replies from something like eight hundred and less than one hundred suitable for our uses. There seem to be a large number of inaccuracies which rendered the returns of little or no use to us. This report seems to develop one idea and that is the necessity of more accurate records in the central stations, and I believe that if this can be carried out it will stimulate economy in the end."

Mr. Burleigh: "Do I understand this seven pounds of coal per horse power hour to be the average? If so it seems far from a fair average."

Mr. Swetland: "If our assumption of ninety per cent. efficiency in the engine and the same efficiency in the dynamo is correct, then it would take seven pounds of coal to generate a horse power hour."

Mr. Nicholls: "It seems to me that the results of the collection of this data, is to show that electric light plants must be singularly inefficient, when the average shows a consumption of seven pounds of coal per horse power hour."

Mr. Vail, of Westbury; "In order that a report of this kind should be fully understood, there should be a classification of the equipments upon which this report is based. The committee says that no attempt has been made to classify equipments. Another important point is that there is no classification as to the quality of the coal. We have two grades of coal, pea coal and George's Creek bituminous coal. All of us who are familiar with the production of steam power know that there is great difference in coal for steaming purposes. There would be a difference of 50 per cent at least in the pounds of coal per horse power hour according to the quality of coal that may be used. The committee concluded with the hope that future reports would show a better average than 88.4 watt hours for one pound of coal. I think if you take the stations as they are installed throughout the United States I doubt if the committee can get a much better average than that from the present status of stations. At the time of the installation of these stations, it was not a matter of economy with many of them, it was a matter of getting in as quick as they could to do business. We have advanced the business here more rapidly than anywhere else in the world and probably at the expense of economic operation. The 88.4 watt hours per pound of coal is about seven pounds of coal per hour. I know of a large number of stations, probably a hundred, running about on that basis. I can point to fifty other stations which are producing a horse power hour for four pounds of coal, and been doing it for several years. I can point to stations of recent construction which are producing a horse power hour for an average of two pounds of coal. That is based on a good quality of screened coal, or clear anthracite pea coal. I think that this report would be much better understood if the committee could have given the details and studied out every item of cost of operation and its proportion to the general percentage on the whole cost."

Mr. DeCamp: "I think that this is not thoroughly understood. I would like to say that an arc lamp—and I must confine myself to arc lamps because I do not know about any others, means 450 watts. This means that it would take about five horse-power to run an arc light. I cannot bring myself to believe, at this late day, taking into consideration all the crude stations that are being operated in this country, that such is the real condition of affairs. I do not think that can be possible; that it takes thirty-five pounds of coal per horse power to make one arc lamp."

Mr. Smith, of Philadelpia: "I call attention to the first sentence of the report; we are reporting on what we found. The point Mr. DeCamp makes is right, but there are other things that have to be considered; and it comes down to this, that according to the statement it takes seven pounds of coal per horse power hour; a good showing all around. There are many more taking ten than three, and the astonishing thing is how few of them know it. They have a test made of their boilers and engines, and I have been in one or two of them and I know how they make them—one man to open the furnace door and another man to throw the coal in. Any station using ordinary engines non-condensing, non-compound doing it on seven pounds of coal per horse power hour, including banking and perhaps running for an economical load six or seven hours in the evening is doing very well. We make the report that that is what the average station is doing, and the next point is what is the best means to take to improve matters. The majority of these stations could very be very much improved with a little extra care."

Mr. DeCamp: "The explanation brings the report a little nearer to my comprehension. You take the coal that is designated; and it runs from the best quality of steaming coal, down to coal having very little steam-making qualities. I have found in my own experince that in using coal all the way from $2 a ton up to $4 a ton, under most excellent conditions for making comparisons, that the $4 coal was the cheapest fuel by 25 per cent., so that if you take into consideration the difference in the variety of coal, all of which goes into the average, the great varety of boilers and engines, and all that sort of thing, I think the statement is a fair one, and that it would fairly represent the coal consumption of the stations as run to-day on an average. I say in a general way that including what Mr. Smith says of the banking and the use of labor such as we are obliged to accept, I think that we in Philadelphia in most of our stations —the more modern ones—have got down to about four or four and a half pounds of coal, but that is the very best coal we can use."

Mr. Van Trump, Wilmington: "I notice the committee tabulates 90 per cent as engine efficiency and 90 per cent as dynamo efficiency. The results tabulated in the report refer to the translating devices on the line, and the schedule says three pounds of coal per indicated horse power shows 201.42 watts per pound of coal. I think that with a station that is burning three pounds of coal per indicated horse power; it is impossible to get 201 watts on the line. I do not think any central station engineer who is running on three pounds of coal could get 201 watts but only 185, out on his line, from which these results are tabulated."

Mr. Swetland: "The gentleman makes a good point. The statement is simply made up for use in the matter of comparison; and of course the 90 per cent of efficiency in the dynamo means directly at the machine; and no loss by resistance in the wire on the circuit is taken into consideration."

The President announced the next order of business to be the report of the Committee on Rules for Safe wiring. Copies of the report of the committee were distributed, bnt the discussion was postponed until Thursday morning.

Mr. W. B. Harington read a paper on "Faults incident to the Protection of Lighting and Power Circuits." The paper started a very interesting discussion as follows:

Mr. Hammer: "I have seen a number of these magnetic cut-outs used on the other side of the water. A year ago Swinbourne making some of his high tension experiments had a small one in connection with his transformer—a simple thing made by a man named Cunningham—two little fingers dipped into a quicksilver cup and controlled by an electro-magnet weight. As soon as the circuit is broken or overloaded this drops down and the two fingers come out of the quicksilver."

Mr. Burleigh: "Has the experience of the central station men been such as to create a wish for a change from the fuse wire to some other device?"

Mr. Robertson of Minneapolis: "We are running quite a number of incandescent lights on an alternating circuit, and we have had considerable trouble with the fuses blowing out or some accident to the machine which might have been averted if the fuse had blown out. We have renewed the fuses each month whether they blew out or not; and I have been looking for a device in the nature of a magnetic cut-out which would do away with fuses. We found it at last, and I have been using a magnetic cut-out on our five hundred volt power circuit, and they have never failed to act in time to save a machine."

Mr. White: "We found it a most efficient protection against lightning."

Mr. Smith: "Fuses are the things that generally cause most trouble. If you put the fuses in as light as they should be, they are sure to give you trouble, slight over-loads, the effect of time or the causes that Mr. Harrington gives uses them up. They are replaced several times, and then the engineer comes and puts in a piece of copper. Our rule has been, when we start with work of that kind, to begin with the lightest fuse that will carry the load, and then run it long enough to satisfy ourselves that the work is all right, and we then take out every one of those fuses and put in a fuse that will thoroughly protect the smallest wire nearly up to the carrying capacity of the wire; the blowing capacity of the fuse being just short of the carrying capacity of the wire. We thereby elimate a great deal of trouble which is caused by putting in fuses heavier than they should be. We find in the dynamo room that regularly changing them once a month is the best. Fuses will in time deteriorate, and a curious fact may be observed when the fuse gets a scale over it and is held together by the scale until it suddenly gives way, and the load is thrown on the other machine and your machine breaks down. The magnetic cut-out would not save us from that always but would likely do it nine times out of ten."

Mr. Brophy, of Boston: "I have seen this phenomenon in fuses that came from the factory. I have tested them and found they would become red hot before they would let go. Fuses are a broken reed on which to lean. Some years ago we had a disastrous fire which was laid, justly or unjustly, to the electric current. We do not know whether it belongs there or not. I never thought it did. In order to allay the feelings in the breasts of the people of Massachusetts, Boston, particularly, a few of us advertised for highly protected fuses, which would prevent an abnormal current getting into any building particularly on the low tension wires which are the most dangerous. We tested them all; and while nearly all of them were ready to combat with an abnormal flow current, none of them would stop the sneaking current. The present method of classifying fuses is all wrong. The fuses may be put in a building for a ten or sixteen-candle light and the fuses are changed to a thirty-two. Of course the same fuses do not serve."

Mr. Vail: "Magnetic cut-outs on lighting circuits have been used frequently at the Schenectady works of the Edison company in the testing of dynamos, and can be adjusted very accurately. It appears to me that there must be a difference made between the cut-outs that can be used in a central station and the cut-outs in a private house or insulated plant. In regard to the action in the fuse, to which Mr. Smith referred, it is due to oxidation. The fuse is made of soft metal and is usually placed under a binding screw of brass. The metals are different and oxidation will in time result. The only way to prevent that in my experience is to have a hard metal end soldered on the fuse—such as a brass or copper tip on the fuse. If the fuse is put into position clean it will be found that the hard metal will prevent the oxidation and no difficulty will occur in that way. Captain Brophy is undoubtedly correct in the statement he makes in regard to replacing small fuses by large fuses. He brought that to the attention of the Edison people some years ago, and I sent some inspectors to examine the central stations. I found a great many instances where circuits of six lights, which had been properly fused in the first instance, had been replaced by a fuse for thirty lights, or a ten-light circuit by a forty-light fuse."

Mr. Smith: "The oxidation under the heads of the fuse is not what I am afraid of. The instances I referred to always take place in the body of the fuse. It is undoubtedly due to some oxidation, which makes the skin of the metal not very destructible by the heat; but it is something new to me to hear that they come that way from the manufacturer. In regard to the replacing of fuses, I happen to know of one fire that was caused by the owner of the house himself. He had a three-light circuit, which was controlled by a plug fuse, and blew out. He put in another three-light fuse, and that blew out. He put in a six-light fuse, and that blew out. He happened to have a forty-light fuse, which he put in, and he burned his house to the ground."

Mr. Hammer: "I think a good deal of trouble might be obviated, if a three-cornered file were taken and run across the fuse. It makes a weak point and causes a tendency to blow out at once if there is an overload. I have done that, and it has taken care of the trouble nicely. Captain Brophy made a remark as to the sneaking current. I have never yet found a fuse or device that will open a telephone line in time to prevent the burning out of the little magnets in the telephone, provided the sneaking current is small enough."

Mr. Orford, of Boston: "As to the gentleman who took a forty-light fuse and put it in where there were three lights, the only thing I can say is that he ought not to have had this fuse in his possession. I have been connected with electric lighting interests quite a number of years, and I do not know of a single instance that has come under my personal observation where the fire was caused by electric lighting wires. I know that if you take up the reports from the Fire Commissioners in the State of Massachusetts they will show you that there is no industry in that state which produces fewer fires than the electric lighting business. The capital invested in electric lighting in that state is a very handsome one, and we are exceedingly anxious to learn all we can about protecting electric lighting devices; at the same time I have never been in a place where I have seen such negligence as here represented to exist. I would like to visit some of these stations where they are burning such a large amount of coal, and the places where such bad wiring exists. I think there are very few such cases. Of course this fusing question has no relation to arc lighting; it is simply applied to incandescent and power service. In Boston, with twenty-five thousand volts, where the current is on day and night, it is unusual to hear of any trouble of any nature what ever, especially from fires. I am not conversant with any such trouble, and have never heard of it. Our method of fusing is to use the simple, ordinary fuse, which we buy in the market. We have magnetic cut-outs on some of our dynamos, but we use also a fuse and switch-board for each circuit, besides the magnetic cut-out to protect the dynamo. Every time we branch from the main we put in a fuse, and every time we put a converter up we put in a fuse. We find little trouble with them, except when we get to larger sizes. The capacity of a fuse is an unknown quantity. I find a fuse made of aluminium, which is going to be the fuse of the future, in my opinion, because it is extremely thin and any undue heat generated seems to melt it quickly. They stamp on each fuse its capacity."

Mr. Smith: "I think the gentleman has misunderstood my remarks. To my knowledge we have had only one fire that has been traced to electric lighting, in twelve years, and that was most criminal carelessness in the wiring. I have put in more than 25,000 lights and have never had a fire occur from bad work. I gave the instance of the plug, to show what was to be avoided."

Mr. Brophy: "I am not one of those who believe that electricity is responsible for fires; not for one atom of the fires it is made responsible for by the public. I have been in a position to investigate fires that were said to have originated in electric current, and not one per cent of the fires could be traced to that cause. The percentage of fires caused by electricity has been insignificant, for years; they are usually caused by matches and kerosene."

Mr. Nicholls: "I would like to ask if any members here have had experience in measuring by meters power supplied for elevators. In starting an elevator you may use 110 volts, and 40 to 80 amperes, and after the elevator gets started this will run down to 12 or 15. Has anyone had any experience in measuring this current? There was a contract awarded for operating some elevators in a government building by electric power, and the government refused to make a meter contract, and insisted upon a flat rate, because the weight of the expert evidence which they secured was to the effect that no meter at present in use would accurately record the current, with such sudden fluctuations."

Mr. Harrington: "I have had a watt meter on street cars, which presents about the same conditions, and the amount of the current recorded was so absurd—two or three amperes—that we abandoned it. The instrument would not record the fluctuations of street car work."

Mr. Carnes, of Memphis: "We have used it only upon a 500-volt current, a regular watt meter, and our experience in that direction has been variable; and the general result has been to discourage us from the further use of the meter in such cases."

The President introduced Prof. T. C. Mendenhall, of Washington, who addressed the meeting on the subject of "Units of Electrical Measure." He said: "I have no doubt that everybody connected with the electric lighting interests of this country is interested in securing legislation upon this subject. I need not, of course, explain to you the necessity for use of electrical units; everybody engaged in this business understands that. It is an interesting fact that, notwithstanding that there are many millions of dollars invested in the production of electricity and electrical instruments and devices, and spite of the fact that in this country we are ahead of the world in electrical matters, we have no legal units of electrical measurement. You are familiar with this matter of electrical units and its history. I will only refer briefly to the fact that an International Electrical Congress was held in Paris in 1881, and also in 1884. The United States was largely represented at both, and you will remember the results of these two meetings. Not a single one of the electrical standards has had a legal recognition in this country; so that if you had a controversy over the amount of the electricity furnished or bought, you will discover that the law in this country, and in every other country in the world except in England during the last few months, does not recognize any unit of electrical measurement. If a suit should be brought, the court in this respect would be obliged to decide on the mere question of tradition; that is, that it had been the custom to measure the current in amperes. During the session of these two congresses it was developed that the people were not ready to accept definitions of electrical units. Expert electricians and scientific men who had come together could not determine what these units ought to be, not being satisfied with their accuracy. * * Congress never adopted formally the pound and yard as standards of weight and measure for the United States. The only measure it has ever adopted is the Troy pound adopted for the coinage of the United States. I think we should take early action in this matter and endeavor to have these electrical standards adopted here before they are adopted abroad. A bill has already been introduced with this object in view and the Secretary of the Treasury has been urged to approve their adoption for use in all departments of the government.

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WEDNESDAY MORNING SESSION.

The president announced the first order of business to be the report on "The Importance of Complete Metallic Circuits for Electric Railways." Mr. J. H. Vail read the report as follows:

Report in full on page 81.

The discussion of the report was opened by Mr. Burleigh, who said: "I feel that the convention owes Mr. Vail a great deal for the very great care used in the preparation of this paper. I understand that the object of the new form of the bond wire exhibited is to overcome electrolysis, do you secure that end with the bond wire shown?"

Mr. Vail: "I believe that the insulated wire bond we could get entirely clear of electrolysis in the pipes. It is certainly evident to any engineer if we offer any better path for the current to travel on—through the rail and through the feeders—it is bound to travel there and not on the pipes. I will say that the system spoken of, of eighty miles of track is completely connected from one pole to the other of the dynamo, through the switch-board, by heavy copper feeders; and several examinations have been made; and there is not the slightest evidence of electrolysis on the pipes in the vicinity of that section of the city.

Mr. Burleigh: "Do you regard the ordinary six bolt fish plate as used with the T-rail, of any value in bonding?"

Mr. Vail: "Whether it be a T-rail or a girder rail, I do not regard a fish-plate of any permanent value in bonding at all. The surfaces become oxidized and after the track has been in use for some time the joints will give way and there is a leakage in the current. The object of the rail bond shown is to provide a flexibility in the joint which cannot be broken by any movement of the cars. It is also to allow that freedom of motion at the joint, and to confine each end of the bond to its original connection of the track so that the track may move but the ends of the bond cannot. You will find on examination of the ordinary bond that in time, when a movement takes place the rail ends break and as soon as that fracture occurs electrolysis sets in under the break and gradully eats them away. I have not had any experience with welded rail joints, I think there so many physical difficulties in the way of that, which will prevent its success."

Mr. Wason, of Cleveland: "I am connected with the Cleveland Electric Railway Company. This is a subject of very vital importance to street railway interests. I had the pleasure of talking not long ago with President Moxham, of the Johnson Rail Co,, which company did the electric welding on the road in Cambridge of the West End company. Their first attempts of electric welding of the rail were not successful. As a company they were inclined to give it up, but urged on by the West End company they have continued their experiments and now think they have got something which will prove efficient. In my humble opinion rail bonds will never do away with elotrolytic action. It must be done by a continuous rail, of the ninety pound section, which most of the street railroads are putting down. That, as Mr. Vail told you, will undoubtedly take care of almost all of the street railroads now running. Possibly in some sections supplementary feeders will have to be used. Mr. Moxham now assures us as a street railway company that they are so situated that they will guarantee perfect work. They have two electric welding machines which cost in the neighborhood of thirty or forty thousand dollars and have ordered two more at about the same cost. They have some 150 miles of track they are under contract to weld during the coming season. Cleveland will undoubtedly have some of this work done. By the way, the joint and the wheels of the motor are the two things that street railway men have now got to contend with. The electric motor has reached an efficiency that is practical. Whatever the rail section, without an electrically welded joint it is bound to go down, in time. The wheel is the next thing to take care of. That is apparently bound to wear out. If some one could get a wheel that would not wear out, as the electrically welded joint apparently looks as if it would always stand, the street railroad man will bless him The trouble seems to have been caused by the breaking of the joints. In Brooklyn they used a fish-plate and the joints was welded some five or six inches from the end of the rail. Now they butt the rail up, and if there is an intervening space put in a shim and weld it there. They now claim to have overcome the trouble with this butt-welded joint, and if they succeed the electrolytical action will undoubtedly cease."

Mr. Law, of Washington: "I agree with Mr. Vail in all he said about making his track as complete a metallic circuit as possible. There is evidently a great loss of current in all street railways from improper bonding. From the manner in which these bonds are placed in the track at the present time it is impossible for it to be otherwise, and after a short time there is a heavy leakage between the bonds and the rails.

Mr. Vail has assumed that there are only two systems. The overhead ground trolley and the overhead metallic circuit trolley. There is another system in successful operation—the metallic underground trolley, wherein the track and rail do not figure in the circuit at all; both positive and negative wires being entirely of copper from generator to motor. The current is entirely cut from the rail, there being no bonding required. The amount of leakage on a system of this kind has been found to be very slight--in fact much less than on overhead construction. If a trolley line is constructed on the lines of this paper, being constructed in first case with ninety pound rail and bonding the rail sufficiently to make it as perfect a conductor as the feeder wire and these feeder wires being buried, as it is proper they should be then you will come into the same or more expense in your construction than you will by putting both wires underneath your track, and using your trolley wire under the track. Such a road as this has been in operation in this city for one year and in Chicago for two years."

Mr. Vail: "I believe Mr. Law is right in what he says in regard to the underground system entire, but there are a great many electric railways built in this country which cannot afford their entire reconstruction and the aim of my paper is to show how these roads already in existence can be helped out and put on a good basis for a reasonable expenditure without putting in an underground system."

Mr. Cuttriss, of New York: "These electric railroad currents that are now beginning to be so dangerous to the water a gas pipes in cities have been a great source of mischief to telephone and telegraph companies for some years. I am connected with the Commercial Cable Company of New York. The commercial cable lands at Coney Island, we go underground from there into the city, we return back and drown onr wires in the sea. Some three years ago they started an electric road running down to Coney Island, and we immediately began to get trouble. For a long time we could not discover the source, but finally determined that it came from the electric railway. I measured the potential over the marshes down there and found the potential higher about one-tenth of a volt in every thirty feet. The difference kept on increasing, being from zero at the Island to New York from eight to ten volts. Now you can imagine what the effect of this would be on a sensitive instrument. Three years ago there were some days during sleet storms when we could not work at all. We have remedied that now. We found that we could not get any damages, because the courts decided that the telephone companies did not own the earth. We have combated it to a reasonable extent; but never will any telegraph company be able to get a natural and pure earth again until the electric railroad systems get a metallic return instead of a ground return. I do not care how perfect the rail connection may be made unless it is a metallic circuit there is sure to be such stoppage as to seriously interfere with all telegraphic business. We have an underground cable running from the Bronx river some twelve miles from the center of the city and about two years they started what is known as the Huckleberry road. Before they started the first car it was all right. Within an hour after running the first car the difference in potential had risen to ten volts. We hope to have the gas and water companies with us in our efforts to have this state of affairs remedied."

Mr. Brophy: "For a good while back there have been certain railroad companies that have been introducing loops from their trolley systems to furnish light andpower. I have fought that steadily, believing that it was dangerous, not to say that they were encroaching on the field that properly belonged to the electric light companies. We have evidence that those who took that ground were right and until the railroad circuit can can be made perfect, it is unsafe to introduce loops fromtrolley systems into any building for the purpose of furnishing light or power. You will find in the rules which will be submitted to-morrow that we have taken strong grounds against this method of lighting."

Mr. Smith: "It is a much discussed point whether the rails should be laid close together or whether any opening should be left for the expansion and contraction owing to the changes of temperature in summer and winter which will tend to twist the track out of shape. A friend of mine connected with a street railway had some doubt about this and his company proceeded to lay a mile of track in which the rails were set butt to butt solid, no space between them at all and they used extra long fish-plates and riveted the rails together with six rivets on a side. They then filled the space between the rails with earth, just below the top of the rail leaving room for the flangs of the wheel, and to use his expression, the track walkers instead of using a wrench, shoved it along. They could not see the slightest difference or movement in it between summer or winter. They allowed slipping joints of three feet at each end of the track and could not see any appreciable movement. The explanation he gave was that the rail being covered up with earth was protected from the weather. It seems to me if we can get a thoroughly welded joint on a street railway track it may stand."

Mr. Wason: "Two years ago our road put in about 1,200 feet of track in absolutely the same manner that Mr. Smith has described. The rail was bolted up with six bolt fish-plate and then one by one these bolts were taken out and boiler makers put in red hot rivets. The rails were butted together as closely as possible. I have noticed this track, when the thermometer was below zero, and also in the hottest weather in summer and it has stood without any appreciable movement. I do not think there is the amount of expansion and contraction going on that we have heretofore supposed."

Mr. Harrington: I have had experience in different forms of rail joints, rivets, and channel pins, using different metals, and I have always found trouble with them. It seems to me in the light of what has been said and done that the best plan to overcome the difficulties is to use such devices as to have a solid butt with a flexible bond, with the butt welded to the rail, and do away with the imperfect contact which has usually been employed.

Mr. Seely: "There is one point that has not yet been brought out in this discussion and which would be of great value, and that is to have your rail lengths as long as possible. The original lengths were three feet, I believe they now turn them out as long as one hundred feet."

Mr. Wright, of Philadelphia: "There is one point in connection with this subject that has not been brought out clearly that the electrolytical action takes place at what we would call the positive electrode, that is where the current leaves the rail and where it leaves the trolley wire. It has been proposed by some of the electric rail companies to some of the gas companies, that they should in the neighborhood of the railway power station allow the electric railroads to make good electrical connection, by means of conductors, to their gas pipes. I had a case in a western city come before me the other day, where it was found very extensive deterioration had occurred in the gas system, and bringing the matter before the city engineer and the electrician of the road they proposed this plan. I think it would be well to warn the members especially those who have any gas connections, against the adoption of any such makeshift plan. It might obviate the electrolytic action in the neighborhood of the station, but the current will find other paths at a greater distance from the station, and the general effect will be the same. I notice that it is proposed by the English Board of Trade to place certain restrictions on the railroad companies to compel them to put in an insulating screen in the neighborhood of their stations to protect the gas and water pipes. I think the experience so far has been that the most destructive action has been in the neighborhood of these stations, and I would like to ask Mr. Vail if the water pipe which has been exhibited was not taken from such a locality."

Mr. Vail: "The last speaker is correct in that respect, but there are other sections of pipe removed quite a distance from the station that are affected in the same way. When electric railways were first introduced we did not anticipate we were going to use water or gas pipes for the return, but now we know better. We admit we have not the right to use another persons material buried in the ground for our business. We started out when there was gas in the pipes and water in the pipes and then there was electricity from the electric lighting system. I remember in 1881 when a certain company in New York City grounded one side of their system and they found that would not do."

The president announced that the subject of Storage Batteries was the next topic for discussion.

Mr. Bracken, of New York: "As one who has been associated with the storage battery interests in this country from its inception, I have been asked by a number of storage battery representatives to open this discussion with a few preliminary remarks. I understand to-day the subject will be confined to their use in central stations. I am afraid that most of the storage battery men will approach this subject with some degree of diffidence by reason of the scepticism that exists in the minds of a very large percentage of central station men about storage batteries. Peace now reigns over the storage battery interests in this country. The companies have come in under one flag and are united for a common interest so that you may purchase a storage battery to-day with the confidence that you are not going to be annoyed by threats of suits for infringement. You not only have the advantage of peace but you also have the advantage of the experience which has been gained both in this country and in Europe by these companies. We had the representatives of several foreign companies here this summer and we got a great deal of useful information from them. It is also natural that you should desire a certain guarantee as to the cost of maintenance and efficiency of the batteries. As to the nature of the guarantees any persons desiring to install storage battery plant in his station can readily satisfy himself as to the life of the plants. He can then guide himself by getting proper guarantees as to the cost of maintenance. I do not think there is any company asking a larger percentage than 10 per cent for the cost of maintaining the battery. I have no doubt that experience will prove the cost of maintenance to be less."

Mr. Salom: "The question of the advisability of the use of storage batteries at the present time in central station plants is purely a commercial one. Will it pay? All of you agree that storage batteries are a desirable adjunct to have in central station practice, but you are deterred from putting this desirable end into practice for two reasons. First, you do not know positively that the investment will show a decrease in operating expenses; second, you are still more uncertain as to the cost of maintenance of the plant after you have made the investment. It is a simple question of arithmetic to determine whether with an additional investment for a battery with a given output and efficiency and at a given cost for maintenance, he can advantageously add to his plant a storage battery. We are now prepared to give responsible guarantees that the maintenance of the battery shall not exceed a certain reasonable cost per annum, and which of course has been duly charged, considered in estimating the additional cost and savings of a storage battery plant. And I would like to add here to disabuse the minds of those who consider storage batteries merely an evanescent adjunct, that the life of a battery under reasonable working conditions is directly proportionally to the amount of load used in its construction. We will undertake to build you a storage battery that will last one hundred years if you are willing to pay for it."

Mr. Appleton: "I would like to draw your attention to something that has been done in this country and which speaks for itself. I refer to the storage battery plant which my company, the Electric Storage Battery Company who manufacture the chloride accumulator have recently installed for the Germantown Electric Light Company. The illustrated sheets which you will find in the seats give a general idea of the battery plant at Germantown, but I believe it is of sufficient interest to this convention to go more fully into the matter and show how the adoption of this battery has changed the state of affairs in this station.

"The Germantown Co. had a day load of incandescent lamps and motors on the three wire system which was very unprofitable, and about 15 months ago they decided to try the use of a storage battery to see if the day load could not be made profitable instead of a dead loss. A small battery was put in sufficient to carry the day load, its capacity was 800 ampere hours with a normal rate of discharge of 80 amperes. The machinery was then shut down from daylight till dusk, the battery taking care of the day load. This being an experiment to ascertain the true facts about the working and value of a storage battery for central station purpose. Very careful figures were kept and the result of the first year's working was eminently successful and resulted in a large saving.

"By the kindness of Mr. Allen the superintendent of the station I am enabled to give you the figures which are as follows: Saving on the one year's running in labor, coal, water, oil, waste, etc., not counting the decreased depreciation of machinery due to shutting down from day light to dusk was $2,500. Besides this there was a great advantage in being able to overhaul and examine all machinery in the day time while everything was shut down. This being so satisfactory and the behavior of the battery being equally good the Germantown Co. decided to put in a battery of 2½ times this capacity which would enable them to increase their day load and consequently increase the savings, as the cost of charging a large battery is only the extra fuel required. This larger battery was installed at the beginning of this year and is the one which I will now describe. The battery consists of 120 cells of the chloride type G eleven plates in each, arranged 60 on each side of the 3 wires system, the capacity of each cell is 1000 ampere hours or 2000 hours with both sides, the normal rate of discharge is 200 amperes and maximum 400 and this can safely be increased in case of sudden demand or emergency.

"The plates are protected by the improved asbestos insulation and are contained in lead lined wood tanks. An asphalt floor well drained is provided so that there is no trouble in handling the acid. One special feature of these cells is the size of the plates of 15x15 inches. Any one who has had experience with storage batteries will appreciate this point and will readily understand how much less trouble and expense there is in the maintenance, when only 11 plates are required to give 1000 amperes capacity instead of about 80 plates as in most other types of batteries. Plates of the chloride type can be constructed larger than this without any difficulty, and give equally good results. The ordinary course of working in the Germantown station is as follows: The machinery is shut down at daylight and the battery carries the whole of the day load till dusk when the dynamos are started again. The battery is then switched out during the hours of heavy load and started in again for charging when the load decreases. By this means the general plant is working at an efficient load during all the hours it is running and the extra fuel for charging the battery is hardly noticeable. The daily routine is very simple, the discharge of the battery is noted by hourly readings and at the end of the day the total discharge is ascertained.

"A charge of about 10 per cent in excess of the discharge is put in and this is found to be sufficient in some cases even less charge than this will bring the cells up to the proper E. M. F. But before the end of the charge, readings are taken in some of the cells with the hydrometer and voltmeter and the condition of a cell can be accurately obtained by the means. The maintenance of a storage battery is the point which frighten most engineers, in the old days 40, 50 and 60 per cent efficiency was the average result and this I believe is the chief reason of the slow adoption of the batteries. * *

"There are many stations in this country which are running the day load at a loss or are losing business by not supplying current at all in the day, to these stations a battery plant would be invaluable and would give a very different result when the balance sheet is taken out. There is another question to which electric light men have to face, how can we profitably reach the outlying districts with our direct current mains; here again the battery plant proves valuable, small sub stations in the outlying districts can be built for the batteries and these can be charged in from say 400 to 800 volts and the current distributed at the required pressure. Every year new electric light men have to look around for a more economical and profitable way of carrying on their business, but let them once realize that now storage batteries can be obtained which will give good results and will not prove a continued source of trouble and worry and they have a way out of many of the troubles. A very good idea of the feeling towards storage batteries was givenonce by an eminent electric engineer, but an advocate of alternating currents; he said the best thing about alternating current is you can't put storage batteries in the currents. Things have now changed, figures, facts and guarantees are obtainable which will enable electric men to feel that storage batteries as a whole are not what they were, but when properly designed, manufactured and installed, are to be welcomed instead of shunned."

The President: "I have great pleasure in presenting to you our friend and former President, Mr. Charles R. Huntley, of Buffalo, who will tell you about a test he has been making."

Mr. Huntley: "Mr. President and Gentlemen, we have been making a test in Buffalo of the appliance which was brought before the Electrical Congress in Chicago. Mr. Patterson came to Buffalo to see me, and as we are usually willing to lend ourselves to our friends, I told him to bring on his stuff and we would give him a circuit and he should run it as he wanted. We assumed absolute control of the circuit on the 4th of February and put it into the hands of one of our men, giving it the same care and attention—no better, no worse—as we did the forty-two circuits running from our station. We did this, however, we patrolled the circuit at night from the hour of burning 5:45 P.M. till 7:10 A.M. in the morning. A representative of the company was with our trimmer. I have with me and will give to you the exact conditions as given to me by the trimmer in his own hand writing, day by day, with the number of lights that were out, how many cylinders were broken and such details, up to the night of the 23rd. The circuit in question is in a residence portion of our city and is tolerably free from grounds, or as free as most overhead arc circuits are, going through trees, etc. The test was made originally of fifty arc lights upon a circuit, and the dynamo was a No. 8 Brush machine, of the latest type, which we got into our station sometime last March—about a year ago. We required quite a number about that time. I will now give his report:

" 'February 7, Ferry corner Grant St., out 1:10 A.M., started itself two minutes later. February 8, Circuit flashed badly until 12 P.M., started lamp Elmwood and Summer streets 9:45 by switching off and on, started same lamp 3, 4 and 5:30 A.M. Carbon burned out 3:10 A.M. Ferry and Richmond. Started Ferry and Grant 1, 2 and 3 A.M. by pulling cable. Stop on clutch too high and lowered arc spring one turn. February 9, 10, 11, and 12, lamps o.k. February 13, put on new cylinders on four lamps. February 14, lamps o.k. February 15, carbons burned out of four lamps. February 16, trimmed circuit, used thirty-three cylinders. February 17, 18, 19 and 20, lamps all o.k., renewed fourteen cylinders and trimmed circuit. February 21, 22, and 23, lamps all o.k., trimmed lamp Plymouth street, cylinder broken.'

"Referring to report of February 8, that night believing that we might run more lamps than the fifty lamps in the circuit, we had installed in the station ten lamps with the appliance on them, and had five lamps thrown in the circuit, but the circuit flashed so badly from the additional load of the five upon the dynamo, that we cut them out and then the circuit went on, and we no longer tried to burn more than fifty lights on the circuit. As to the large number of the renewals of the cylinders on the 16th, on that night and the date previous we had a very heavy storm of soft snow—about 16 inches of snow fell. The hood or storm protector of the lamp was of such a character that much of the snow blew in and as the water struck the appliance on globe, which is intensely hot, of course it broke. "The general characteristic of the light is somewhat different to the eye of the public than from the ordinary arc lamp. The rays of the light are not as strong, but after the circuit was in good burning order we found that the street was better lighted owing to the horizontal ray of the arc than by the ordinary arc which gave an intense light underneath but did not diffuse the light into the middle of the block. The burning of the lamp or carbon is such that they form no pencil or crator as they do in the ordinary arc, but burn very slowly and with square ends. The claim of the maker is that they give a luminous body caused by the carbon monoxide gas; and up to the present time it has worked very well in Buffalo.

Mr. DeCamp: "What is the purpose of that lamp, is it to save carbon and give a better illumination?"

Mr. Huntley: "Yes, that is the claim as presented to me."

Mr. DeCamp: "As a matter of fact what was the saving of carbon: how many times did you trim?"

Mr. Huntley: "We trimmed every four days."

Mr. DeCamp: "Was the consumption of the carbons uniform?"

Mr. Huntley: "Practically so."

Mr. DeCamp: "Was it the ordinary standard carbon?"

Mr. Huntley: "No, it was a special carbon, which the gentleman sent on to us and in the manufacture of which there is a secret process. The tubular cylinders, hoods and carbon were furnished by the gentlemen who desired the test."

Mr. DeCamp: "Your own opinion is that the general illumination was better for street lighting?"

Mr. Huntley: "Yes, sir."

Mr. DeCamp: "What was the opinion of the public?"

Mr. Huntley: "The residents are well satisfied with the illumination; perhaps better than they were with the other circuit."

Mr. Morrison: "How long did the experiment last?"

Mr. Huntley: "They began work about the first of September, and we took the circuit on the 4th of February and cared for it in the same way as our others."

Mr. Nicholls: "Did you find any saving in the trimming, or was it necessary to have a trimmer go around constantly to find if any of the lamps were out?"

Mr. Huntley: "We found no saving in the trimming on this particular circuit, because we put one man right there. The claim that is made is that the lamps will burn from 80 to 100 hours and that a trimmer will take care of about 400 lamps. Experience will be quite a teacher in this respect."

Mr. DeCamp: "This is a very interesting subject and I should like to know in what respect does the principle involved in this cylinder differ from that which was involved in what we had eight or ten years ago—the Baxter lamp."

Mr. Huntley: "I am not at all familiar with the Baxter lamp."

Mr. Morrison: "It is a modification of the old Baxter lamp."

Mr. Marks, of New York: "In looking over the patent situation on this question, I find, as Mr. DeCamp said, that arcs of this type were run years ago. The question which suggests itself is why were they not successful? There are numerous reasons. I do not know that I will have sufficient time to go into the causes in detail now but some of these reasons you will remember were answered at the International Electrical Congress at Chicago last August. I remember that one of the gentlemen who discussed the subject at that time said, 'I tried something of that kind about five years ago in Cleveland, and I found that the bulb blackened in half an hour, and I do not believe it possible to obtain a carbon which will not blacken the cylinder in a few hours; that was one of the numerous causes that led to failure in former years.' I need hardly say after Mr. Huntley's remarks that we have obtained a carbon which give successful results to-day. Another cause of failure was the character of the surrounding chamber. We have a composition which is analogous to glass. In my talk before the International Congress last August, I called it glass. Five years ago the substance which was used appeared to be something that was different to glass; the arc having been sprung the chamber exploded frequently. The heat was sufficient to crack the glass, letting out the carbon monoxide gas and in some instances cause explosion.

"We find that if we have an arrangement such that the enclosed gas has an opportunity to escape, but the ingress of the air is practically prevented, the pressure on the inside of the cylinder is less than on the outside. If the pressure on the inside of the cylinder were greater than the pressure on the outside, we might expect an explosion; but under the conditions mentioned, I fail to see how it is possible, under any circumstances, in the normal operation of lamps on a commercial circuit to explode the cylinder. I put myself on record as stating that I have never known a cylinder, with a plug and controlling arrangement for the gases, as used in our type, to explode; and I think I may refer to Mr. Howard, who is the pioneer in the development of this new type of enclosed arc, that in his experience he has not known of a case of explosion.

"Mr. Huntley has called your attention to the crater. The character of the light, its distribution, amount, etc., are points in which I am interested and to which I have given a great deal of attention. I experimented on an arc at Ithaca last summer in order to determine the effect of coating the cylinder with various ingredients other than carbon; and Dr. Nicholls called my attention to the remarkable gain in the distribution of light. He said in the normal arc in the open air we have a maximum of between 40 and 45. In this type of arc the crater extends practically over the entire surface of end of the carbon. The results of tests according to my observation are slightly different from those of Mr. Huntley, regarding the shape of the tip. The crater is not exactly flat, but it extends over the entire surface of the carbon, being slightly hollow. We hope to have an opportunity to show you the carbons which were placed in the lamps now burning in the rotunda of the hotel last Saturday afternoon. They have several nights yet to burn; but we shall take them out and show them to you." The meeting here adjourned until 2 p. m.

WEDNESDAY AFTERNOON SESSION.

"Are there further remarks to be made upon the arc light subject?"

Mr. De Camp: "Mr. President, I am a seeker after information relative to this subject. I know nothing about it. But taking it on its merits, it is simply an economic question. As I understand it there are two elements on the saving side of this question: first, the consumption of carbon; second, the saving in labor in re-setting those carbons against which you have but possible increased cost in the carbon and the cost of globe or cylinder—not only the original cost, but the cost of its maintenance. The vital point is whether the saving in the two particulars mentioned is off-set by the increased cost of the other two. Looking upon the question in the light of economizing in the cost of electric lights, I am inclined to think that it will not be as seductive to the station man who operates his lamps for money as it now seems to be. But there is another thing that has not been touched upon at all this morning, but which should be very seriously considered, and that is the question of saving in labor in trimming—whether it is a real saving or not. I have my doubts whether a lamp can be trimmed with the absolute certainty that it will burn an hundred hours. The question with me is whether it is safe to count that labor as all saved. I do not see anything in this system that is going to obviate the necessity of cleaning the lamp.

"Now, one of the things which is most essential to good service in the open-air arc light (and as I say I do not see why there should be an exception in this) is the opportunity for a proper cleaning of the lamps. The attention which a good competent trimmer has to give to the matter is to be taken into consideration, and his ability to discover by the consumption of carbon when he trims the lamp, whether that lamp is out of adjustment or is in the process of getting out of adjustment. If I am correct in my premises then it is going to take a man every day to go over the lamps and look over those things. If that be necessary, then you must reduce the saving in the labor question only by the difference in the amount of work done by the trimmers actually putting the carbons into the lamps adjusted. The most difficult and most important question in the convention is the cost of producing arc lights."

Mr. Howard: "In relation to the matter referred to by Mr. De Camp, in regard to cleaning the light rod, I think that the requirements change with this new equipment. Instead of 8 1-10 inches for part of a night's run. there is less than an inch of that rod that is used. No doubt in trimming the lamp it needs inspection after the first trimming; but having started properly, the adjustment of the lamp in its mechanism fitted to the requirements, it needs no further attention in regard to inspection until that run is completed. In regard to saving, it has been reported to me that the idea of income—and it is the commercial end that I wish to look at—is the royalty. Such is not the case. It is proposed to furnish this equipment to the central station at a fixed price, guaranteeing a saving on those two items of carbon and trimming to be at least twenty per cent on the cost as it exists under the present circumstances. In the matter of breakage, I have to say that all new enterprises are obliged to go through a certain amount of experimental work. We had a slight storm here on Monday night. One might have thought that we were were in Buffalo. The lamp on the corner of F and 14th streets went through that storm. Perhaps it is a little better arranged than those that are in Buffalo.

"In relation to the available light for energy. I think I shall refer you to tests that were made at Cornell. The figures were published. I would like to have somebody discuss that matter who knows more about the dynamo than I do."

Mr. Brown: "Does the lamp take the same voltage in current as the normal arc lamp?"

Mr. Howard: "It does."

Mr. Brown: "Can you tell me what it does take?"

Mr. Howard: "Sixty-one to sixty-two volts and kilowatts of about the same."

Mr. DeCamp: "Kilowatts of what?"

Mr. Howard: "A little less than five hundred."

Mr. Smith: "We had one of those machines, and we had it under conditions which gave us favorable opportunity for watching it, and the diffusion was better. The lamps were compared; taking a lamp of the same number of kilowatts run at the central station and kept in good order, and the actual amount of light furnished by the lamps was the same. But at a distance we found that we got a better light. We thought the trim was a big item, four nights without being trimmed. But we discovered in the first week's run that that was not so. Having trimmed the light the first night it worked beautifully, but the next night it would not start. We tried to get rid of that by arranging the carbon and stiffening it, and we still found that the lamps did not actually wedge; that the alignment of the carbon was not good enough to allow us to run more than one night without trimming. The man did not have to trim, but he had to climb the poles to see that the carbons were right, and the whole attention to those lamps practically took as much time as would the trimming. I do not care how many lamps you run, you might save one or two trims; it takes less time than to trim; yet you would have to keep a man going over the trim-circuit. In the arc light that was a bigger trouble, having one man going over another man's work. But, I judge, the saving of one or two trimmers and the patrolling to save them would pay for the extra trouble you would have with the apparatus.

Mr. Huntley: "I am satisfied from the researches that I have made that there is a possibility, perhaps, in certain lights provided the gentleman can take a dynamo which can be made properly for a specific current. It may be of one kind or the other; of what utility is this to us in an economic sense? We have not the money; there is not one of us has the money to throw out one dynamo and put in something else in its place. But if this appliance will fill the bill, cheapen the product, cut the trimmers down, save carbon and save twenty per cent in cost of operation. I am inclined to think that it is something we want to take up, or at least look into it. But the gentleman who have this thing in active operation, who are going to sell it to us (by what methods I do not know—individually or collectively)—no better time exists than now to inform ourselves as to what we are to expect from this sort of thing.

"Now, is there in this a saving over what exists to-day in the station? Can it be made a saving to us, or do the other fellows want all there is in it and we get nothing? Those are questions that come right home to the pocketbook of every man who makes an arc light. It is an economical problem. I am thoroughly satisfied that the diffusion of light is as good to any citizen that may look at it as the arc light, and I am not sure but it is better. I am only speaking now of our experience in using the lamp out of doors.

"There are many things in connection with the arc lamp that I have told Mr. Howard and my friend, Prof. Marks—that the arc light has got to shake hands with every 365 days of the year. You are dependent on a duty that is growing more exacting all the time, and whether you can leave an arc light up on the corners subjected to the winds and weather, as we have them in Buffalo, exposed to the small boy with the air gun trying to shoot the globe off or to kill a sparrow. These things exist with every one of us. The trimmer goes around in the morning and finds the clutches are wrong, and the citizens on that street have light, but whether we can leave a lamp hung up in the air for four or five days without having anybody go to see it, is a very grave question to me. I believe the public expects to be served as you and I are served individually in our meals—right; otherwise they do not want it, and it seems to me if this will enable us to do it it will be a good thing for us to adopt.

Mr. Stetson: "In this twenty per cent of saving I think it would be a good idea to include the dockage by the police in blowing out the lamps. We are lighting on the moonlight idea, and I find, as Mr. DeCamp has suggested, that the lamps do not burn after a moonlight period as regularly as after they have had two or three nights' run. We have our police report every morning of lights out, but that is a serious matter because they are deducted every month from the number that we hand into city for pay. If there could be a deduction of twenty per cent on that, this lamp is something we ought to have.

"There is one thing in this lamp that has not been touched upon and that is whether it is a better lamp for commercial purposes. We not only want the cheapest thing but the best thing. I am satisfied that the street is not the best place for it, but that it may be a good lamp in stores, and if it is better we could stand a little additional cost."

The President: "I shall have to close the discussion on this topic now. The next topic is, 'What is the most economical size for arc dynamos?' This subject will be open for two or three-minute discussion by several gentlemen. First, Mr. Huntley will speak."

Mr. Huntley: "Why the President and Secretary put me down to open this discussion is more than I can say, unless they have been in one of our stations and found a lot of stuff of all sizes and weights, and concluded that I had the experience necessary to inform this convention which size was the more economical one. I do not know that any one of us can make a cast-iron rule and say which unit is the more profitable one for us to employ, and what I shall have to say on this matter will be confined to that which I think it is right for us to use with the long distance that we have to cover and the number of lamps we have upon the circuit, together with the floor space, capacity, etc. If I were to place an order to-morrow I would try to get a 100-light machine.

"The natural criticism of that statement is that your voltage is going to be dangerous. Not being an electrician I cannot say, but in our experience we have had occasion to put two machines together on our dock lighting and I have found that there is no difficulty; in fact, nobody knows the difference, not even our selves, of multiplying two 60-light machines together. If we could get that power in one machine designed as efficiently and as free from burning out the armatures, I would be in favor of a larger unit. We are certainly working an 80-light machine, and I would not like to be on record as advocating less than a 100-light unit, if we can get it."

Mr. Redman: "In regard to the size of a machine I would say that personally I believe in a large unit, but like my friend we have been using five or six different kinds of apparatus, and we are situated differently from other companies in regard to the voltage. We are prohibited by our contract with the city and city council from exceeding 3,500 voltage, and with the Brush company 3,400. We would like to try an 80-light machine, or 100-light machine, but we are prohibited."

Mr. Ayer: "I have had considerable experience with the arc lighting dynamos of the larger units, and from the point of maintenance of alliance relation and armature relation, I have not been able to distinguish any difference between those 60-light machines and the smaller. Machines equally well made seem to stand up. It is impracticable to build a machine of the gramme type of armature which you can easily operate at 4,000. I have no 4,000 or 4,200. In the operation of the station we carefully noted and kept record of the line troubles on the different circuits, and the record on the 80-light circuits showed no greater trouble than those on 60-light circuits. I operated for about two years and a half about thirteen 80-lighters, with more of them put in—nine of them at one time. In a station where the number of lamps in operation would justify the use of the large units, I think there is no question as to what should be used. Of course, in small central stations where the aggregate output would not amount to more than a load on one 80-light machine, it is preferable to divide your units, put your station equipment into three dynamos, three 60-light machines, perhaps, or three 50's or rather two 80's, assuming all the time that you would provide the necessary force. The only economical question in the arc lighting dynamos is in the station. In the station the largest machine obtainable is the most economical, the facility with which you can combine circuits on dynamos enables you to do it comfortably. In the small station I had the same experience that our friend, Mr. Huntley, mentions, operating stations which were the growth of time, and where we had dynamos of all sizes. So soon as practicable I made the circuits as large as our largest units, to reduce the number of circuits that we would have to care for, and the way that we were compelled to use the smaller machines was to run them in series. I was always unwilling to couple up the circuit-dynamos of four hundred lights, so as to get the voltage four or five thousand volts. I made some experiments with two 60-light circuits coupled together for sixty days, and did it in wet weather purposely. We found in a lineage with 120 lights, with two 60-light machines it was dangerous in the station, but we guarded against accidents there. We could not secure the usual lineage relations with such high pressure. We found that the current could be detected on the ground, that by touching with a wet towel there was leakage through the insulators. I made it an iron-clad rule in the station that no such rule should obtain. In my experience you cannot run any higher than four or five thousand volts on a circuit; that when you get six or seven thousand you are getting too high. But this is a matter of insulation, something we hope to overcome. Taking conditions as they are, I think there is no question that an 80-light dynamo is perfectly practicable."

Mr. Peck: "The question here presented is as to the most economical size of dynamo. To me that is a question of condition. You can take the city of New York, or for a better example, the city of Brooklyn. There we branch off in all directions from the central point, and we can use dynamos of greater units to advantage: whereas in the city of New York the shape of the city being long drawn out naturally, it is more economical to use a circuit of larger unit. We find that 2,500 volts are about all we require to insulate. I am strongly in favor, therefore, of smaller units."

Mr. De Camp: "I would like to say a few words additional on the subject. I never did understand why there should be any objection to the larger machine. I was asked the question what was the best machine to use. I should say the largest machine you can get everything else being equal."

The President: "The next topic is one which was made the special order for four o'clock, and is, 'How to Rate Arc Lamps.' There is pending, to be discussed in connection with this subject, a resolution offered by Mr. Burley with relation to the definition of the term 'Two-thousand candle power.'"

The resolution was read for information, and after some discussion was referred to a committee of five composed of Messrs. Mendenhall, Anthony, Weston, Hammer and Forbes with instructions to report the following day.

THURSDAY MORNING SESSION.

Vice-president Francisco called the meeting to order and Mr. A. B. Herrick, read the following paper:

Development of Switchboards for Modern Central Stations.

BY A. B. HERRICK.

Mr. President and Gentlemen of the National Electric Light Association: In the designing of central stations a great deal of attention has been given by electrical engineers to the subject of switchboards. Too much attention cannot be well directed to this branch, both in regard to the concentration and the consequent reduction in the space which it occupies, which leads to reduction in first cost. Care also has to be given in combining and placing the apparatus in such a way that the cost of attendance will be as small as possible, besides always having in view methods to give the greatest flexibility possible to the system.

There are elements common to both high and low potential switchboards, although varying greatly in regard to detail and general circuit arrangement, and there are certain common practices that have grown in favor, that can be treated independent of the special service required, and the potential at which the board is operated.

In regard to the location of the board, the universal modern practice both abroad and at home, is to place the switchboard in a gallery or in some elevated position, where the attendant has full observation of the operation of the different units under his charge, and can judge, in the case of any peculiar behavior of the generators, the proper remedy to be applied, and be prepared to take the unit off the circuit if necessary.

There is another marked general tendency in switchboard construction, that is, to make the whole structure absolutely fireproof. There is no reason why a central station should contain any combustible material other than the necessary waste and oil. There is at the command of the electrical engineer to-day fire-proof material for every form of switchboard, and insulation necessary in central station construction.

Every advance advocated by insurance inspectors in this direction is important for the central station manager to follow, and thus to preserve his property from destruction by fire. This is, of course, an economical investment, for lower insurance rates are easily obtained on central stations properly safeguarded.

In the case of low equal potential distributing systems, especially in the three-wire feeder and main system, the switchboard arrangements bear a very important relation to the satisfactory operation of the system. The advance in this line has been so marked in the last few years, that it will repay us to review the past history of the low potential systems of distribution in a few words, and to seek clearly the causes that have made it necessary to introduce the modern novel methods to increase the economy of operation in production and in effective distribution of the current.

In order to distribute the current at a high economy by means of the feeder and main system, it is necessary to place the station at the average center of distribution. This simple proposition is complicated by the fact that a city is divided into business and residential portions, each having different periods of maximum demand on the station, and as these districts are not generally symmetrically located, as regards the station, the center of maximum efficiency of distribution travels over considerable distances during the day. Different methods have been adopted in the past in order that the station may deliver its current to the mains at an equal potential; in other words, artificial means have to be used to bring the varying center of distribution to the station.

The first means resorted to was to introduce into various feeders an artificial adjustable resistance, to compensate for the unequal losses occurring in the feeders, so this method has become obsolete in good practice. The immediate remedy was to put in more copper in the form of new feeders and larger mains, but as the low potential systems have been expanding over larger areas to include a greater number of customers, it has again become necessary to deliver current at the station ends of these feeders of different potentials to compensate for the unequal loading of the system.

This was originally effected by running the dynamos at different potentials, feeding into independent busses, the feeders being so arranged that they could be thrown on any of these busses and supplied with current at the proper potential, to deliver their current to the mains at a uniform potential. When the units in the station were small, they could be divided up on the different busses with comparatively high economy; but, as central station business has expanded, units had to be adopted both for economy and first cost per Kilowatt, higher economy in current production, and to obtain a larger Kilowatt out per square foot floor space. With the introduction of these larger units two conditions confront the engineer; one—it was necessary to run the unit at nearly the maximum output, in order to get the maximum efficiency of the generators and engines combined; and the other, to deliver this current at two or more potentials to different groups of feeders.

To follow the ordinary load diagram of a station, beginning at the lowest point, it is very rarely required to produce the current at more than one potential. Here all the feeders may be thrown on one bus bar, or the bus bars may be tied together. As the load rises certain feeders will become more heavily loaded, and they will have to be supplied with a current of high potential, but to run a large unit on this high potential bus, where the load it has to carry is a small part of its total capacity, it would be an uneconomical method of producing this current, as the unit under these conditions is working disadvantageously both as regards expansion of steam in the engine, the friction, field and armature losses.

Several different methods are now used to effect a higher economy in the delivery of the current to the buses. Mr. Barstow, general manager of the Brooklyn Illuminating Company, has devised the well-known "Booster" system. This method works out very well where three potentials are required. The medium potential bus in this case is fed by the units operating the station; the current is delivered from the medium bus to the high potential bus through the armature of a dynamo whose field is separately excited. The current in passing through this armature has its initial potential exalted, and the amount of this increased potential is controlled by a field regulator. The currents supplying the bus of lower potential than the medium bus also flows through an armature, but in this case the armature is rotated as a motor and has its initial potential reduced.

In three-wire system two "boosters" are required for each potential, and it is the usual practice to couple these boosters together, making one continuous line of shafting, to which is also coupled a motor for the purpose of keeping the boosters up to full speed and making good the losses due to transformation and unequal loading of the high and low busses. The losses inherent in the booster system are those occurring from friction, armature losses, and field excitation.

A method has been devised by which to obviate these losses, a dynamo can be used to produce on a single armature two or more potentials. Where the difference of potential is small, and where the load on the high and low busses does not fluctuate very rapidly, a smooth body multipolar, direct-driven dynamos can be used; but where the differences of potential and load are extreme, a special dynamo is applied and different parts of the armature run at different potentials and on two or more separate busses. Its action will be similar in every respect to that of two or more independent dynamos. The different parts of the armature giving different potentials are controlled by separate regulators and the load on these separate busses carried to a point at which it will be economical to operate a separate unit. Then this special dynamo can be connected to any one of the busses in the same manner as any other unit in the station. The different parts of the armature are brought to one potential and thrown in on any required bus in the same manner as in the operation of three separate dynamos. In this way some of the losses inherent in the booster method are obviated, and full economy of the supplementary bus output is always obtained; and the full load of these auxiliary busses being carried by the one dynamo, brings the output of this dynamo up to an efficient point, both as regards the operation of the engine and dynamo.

After having thus reviewed the methods of producing different potentials in the station, we come to the modern switchboard which has required very careful thought on the part of the engineer to make both simple and easy. Following the natural operation of the switchboard provisions made to take care of the field circuits are the first requiring our attention. In the introduction of the modern multipolar machine great attention was necessary in the field circuit arrangement; and the proper method of exciting dynamos is still an open topic. Two methods are commonly used, each having its own peculiar advantages and specially applicable to different systems—the Self-Exciting, Bus Exciting. The advantages and disadvantages of these methods are as follows:

In Self-Exciting method the field terminals are connected to the brushes. The advantage of this is, that the field gradually dies away as the dynamo slows down, and when the dynamo has stopped the field has entirely dissapeared. The danger of a sudden discharge of the field, which would submit the field winding to a strain, on account of the high potential induced, or breaking down the armature is thus avoided. The disadvantages of this method are, 1st—the slowness with which the dynamo builds up its own field, as the dynamo frequently runs at full speed for some time before it develops sufficient electro motor force to be connected to the system; 2nd—the possibility that the field may build up reversed. This may be caused by the sudden discharge of the field by a short circuit, or even by proximity to another dynamo.

In the Bus-Exciting method the fields are connected to the station mains or busses. The advantage of this method is, that the field is instantly made and the dynamo can be connected into the system as soon as it is up to speed.

(*Paper and discussion concluded in April number.*)

After the discussion of the above paper Mr. Chas. F. Scott read the following paper.

Polyphase Transmission.*

BY CHARLES F. SCOTT.

When alternating current was introduced for lighting it presented many new problems to the electrical engineer. Numerous difficulties and dangers were predicted by the theorist, but in ordinary service most of these have fortunately lain dormant. These difficulties are apt to appear, however, when alternating current is attempted on a large scale. The introduction of larger units, heavier currents, higher potentials or power service are apt to increase the effects of self-induction and capacity, so that they will now demand careful consideration. The impetus which electrical engineering is receiving from the introduction of the Polyphase system, which brings with it large units and long distances, naturally directs attention to the natural problem of alternating current transmission and distribution.

A complete and exhaustive solution of this problem is by no means a simple one, and the attempted solutions generally lead to formulæ and diagrams which are possibly even more perplexing than the phenomena. If even the electrician who devotes all his energy to new problems can scarcely keep abreast of the times, it is not surprising that the practical engineer and station manager become perplexed and confounded at the apparently erratic phenomena observed in practice or described in print. Theoretical articles appear on variation in wave form, harmonics, so-called Ferranti effects, increased resistance in conductors with alternating currents, hysteresis, peculiar magnetic circuits, resonance, oscillations, lag, capacity, self-induction. Many of these articles, although evidently intended to be of service in engineering, show apparently no adequate appreciation of the practical bearing and relation of the subjects treated. Consequently the average engineer becomes bewildered and perplexed, and concludes that theoretical explanations are of little value to the practical man. There are, however, many points of great practical importance which admit of fairly simple statement and explanation. The particular element to be considered in the present paper is the transmission circuit.

One of the fundamental characteristics of alternating current working is self-induction. The effect of self-induction is most readily shown by a simple experiment. A wire having a resistance of ten ohms may be wound in a coil. Ten volts will send a continuous current of one ampere through this coil. An alternating current of a certain frequency will require 50 volts for producing one ampere through the same wire. If a one ampere, 50 volt lamp be placed in series with the coil and a current of one ampere be passed through the two in series the E. M. F. required for continuous current is 10 volts on the coil and 50 volts on the lamp, or 60 volts across the circuit, and the E. M. F. required for altering current is 50 volts across the coil and 50 volts across the lamp, which gives not 100 volts, but 78 volts measured across the two in series. If two lamps be placed in multiple and connected in series with the coil 2 amperes will require for continuous current 20 volts on the coil and 50 volts on the lamps, or 70 volts across the circuit. For alternating current, the E. M. F. on the coil is 100 volts and on the lamps 50 volts, and on the circuit across the two in series, the E. M. F. is 120 volts.

The two lamps which are in multiple may be placed in series with a second coil so proportioned that an E. M. F. of 50 volts will send one ampere alternating current through the combination, and a continuous current of one ampere would be caused by 35 volts. This combination may be treated as a unit and may be used to replace the single lamp in the above test. If this combination be placed in series with the first coil, the E. M. F. required for sending a continuous current through the circuit will be 10 volts on the coil and 45 volts on the circuit. If the alternating current of one ampere be sent through the circuit, 50 volts will be required across the combination and 50 volts across the coil, the same as with the single lamp, but the E. M. F. across the circuit is no longer 78 volts, but has increased to 95 volts.

The important facts to be noted in these experiments are (1) that the sum of the alternating E. M. F.'s on the elements in series is greater than that required on the terminals; (2) that the alternating E. M. F. for supplying the lamps in series with a coil is greater than the continuous E. M. F. and (3) that the difference between the two becomes greater as the number of lamps is increased. It is also to be noted (4) that if the same alternating current be supplied through a coil, first to a lamp alone and then to a combination including lamps and a coil, a higher E. M. F. is required when the combination is used.

These relations, which seem rather perplexing, may be illustrated in a very simple way by diagrams. In the case of the coil alone, in which 50 volts are required for producing one ampere alternating current and 10 volts for one ampere continuous current, these two E. M. F.'s may be represented by the hypothenuse and one side of the familiar right angle triangle. The remaining side represents the counter E. M. F in the coil. If a second wire had been wound in this coil in parallel with the first it would be found that when one ampere is passing there is an E. M. F. on the terminals of the second, or idle wire of 40 volts. This E. M. F. is caused by the field produced by the alternating current. An equal E. M. F. is of course induced in the wire carrying the current, as the two wires occupy virtually the same position. This counter E. M. F. is seen to correspond with the third side of the triangle. Suitable measures show that this counter E. M. F. occurs later than the current through the coil and that the maximum value occurs when the current is passing through its zero. This relation is shown in the diagram by the 90 degree relation of the lines representing counter E. M. F. and the volts required for sending continuous current through the line.

An ordinary circuit may be considered as a choke coil in which there is a single turn. The action in this case is very similar to that illustrated above with a coil of many turns. The effect of self-induction in a circuit may be most readily understood by some simple diagrams. A current of say 5 amperes is delivered at 100 volts over a circuit of 1-5 of an ohm resistance. The self-induction of the circuit is such that 5 amperes generates a counter E. M. F. of 10 volts. Both continuous and alternating currents are used and the generator E. M. F. is in each case adjusted to give 100 volts at the load.

The load consists first of five incandescent lamps (1). A coil of high self-induction is then added, which increases the current from 5 to 5.1 amperes (2). One of the lamps is then cut out and replaced by coils of such a self-induction as to give a total of 5 amperes (3). Then all the lamps are cut out and coils substituted of such a number as to take 5 amperes at 100 volts (4). The E. M. F. required on the generator and the resulting drop, or difference of E. M. F. at the dynamo and at the load are given in the diagrams and in the following table:

	Continuous Current.	Alternating Current.			
	No. 1.	No. 1.	No. 2.	No. 3.	No. 4.
Current in line	5	5	5.1	5	5
" " lamps	5	5	5	4	0
" " coils	0	0	1	3	5
E. M. F. on load	100	100	100	100	100
" " line	1	10	10	10	10
" " generator	101	101.5	102.5	106	110
Drop-total	1	1.5	2.5	6	10

It is to be noted that with exactly the same circuit for supplying five lamps with the same amperes at the same E. M. F., there is an increase of drop between generator and load when continuous current is replaced by alternating current. This drop is much less than the volts required for sending the alternating current through the line, and it moreover increases enormously as the load becomes even slightly inductive. Thus when the current is increased only two per cent (from 5 to 5.1 amperes, Nos. 6 and 7) by the addition of inductive load to the lamp load, the increase of drop due to self-induction is increased from ½ per cent to 1½ per cent, or an increase of threefold. When the load consists of four lamps and coils are added in multiple to take a total of 5 amperes, or the same as that taken by the five lamps from the generator, the drop is four times the drop when five lamps alone are in circuit. If the remaining four lamps be replaced by coils, the drop does not increase in proportion, but from 6 to only 10 per cent. The effect, therefore, of a slight self-induction in the load causes a much greater proportional drop than the presence of a large self-induction. A counter E. M. F. of 10 per cent is not at all likely to occur in a 100-volt line carrying small current. The figures given, however, serve as an illustration of the percentage varitions which are liable to occur in other parts of the system.

The word "drop" in continuous current calculations has a perfectly well defined meaning. In the case of the five lamps which take 5 amperes at 100 volts through a circuit of one-fifth of an ohm as illustrated in No. 1, the drop is (1) the difference between the E. M. F., at the generator and at the lamps, or one volt, which is one per cent; (2) it is the E. M. F. required for sending the current through the line. This is equal to the current multiplied by the resistance, and is the E. M. F. which would be required for sending the current through the line if the load be short circuited; (3) a drop of one per cent means also that the energy lost in the line is one per cent of that delivered by the generator; (4) a loss of one per cent in the line also signifies that the energy delivered is one per cent less than that supplied by the generator.

In alternating current work the same uniformity does not exist; for example, in the experiments with the same five lamps and the same line, (1) the generator pressure was 101½ volts, or one-half per cent higher than that of the lamps; (2) the E.M.F. required for sending a current through a line short circuited is 10 volts, or 10 per cent; (3) the energy lost in wires is $C^2 R$, or 5 watts, which is one per cent of the energy when five lamps are supplied. If four lamps and low resistance coils are connected to the circuit, the energy delivered is, say, 400 watts and the loss is 1¼ per cent; (4) if the coils alone are supplied and their combined resistance is equal to that of the circuit, or one-fifth of an ohm, then the losses in load and line are equal and the actual line loss is 50 per cent. The apparent energy at the generator is 550 watts (110 volts and 5 amperes) and the apparent energy delivered is 500 watts (100 volts and 5 amperes) so that the apparent line loss is 9 per cent.

It is therefore evident that the several elements commonly referred to as drop or per cent loss with continuous current are so modified when alternating current is used that it is possible for no two of them to have the same value. Moreover, with alternating current none of these elements may have the same per cent value as that for continuous current on the circuit.

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*Read before National Electric Light Association, Washington, 1894.

The two vital factors in the line are loss and regulation. The losses are C^2 R and should be expressed in watts or horsepower, or as a per cent of the energy delivered to the line. The practical point in regulation is the difference in E. M. F. at the generator and at the load. When these two factors are known it is generally immaterial what E. M. F. might be required for sending current through a short circuited line. The word "drop" is applied to the difference in E.M.F. between the generator and the load. The regulation is generally expressed in per cent of generator E. M. F., but in this paper the E. M. F. at the load will be considered 100 per cent as this is the element to be kept constant while the E. M. F. of the generator is variable, depending on the load and other elements.

The regulation, or drop in the alternating current circuit is dependent largely upon the counter E. M. F. of the line. The factors which practically determine the counter E. M. F. of the line are size of wire, distance between wires, length of circuits, frequency and current. Mr. A. E. Kennelly has given very complete curves (American Institute of Electrical Engineers, April 1893) for determining the impedance of pole lines. The impedance factors given may be used for finding the current through a given line which is short circuited at one end when the E. M. F. and frequency are known. The impendance factor of the line for supplying five lamps described above is 10, as the alternating E. M. F. is ten times the continuous E. M. F. for the same current when the line is short circuited. The word "drop" is applied in Mr. Kennelly's article to the volts required for overcoming impendance in a circuit, and the impression that this is the same as the drop in continuous current circuits was not corrected in the paper, nor was this most practical point raised in the discussion. The relation between impedance and loss was, however, demonstrated mathematically in a communication after the meeting. The figures given in connection with the foregoing diagrams show very clearly that a circuit having the same impedance may have a drop between the generator and the load of from 1½ to 10 per cent, depending upon the character of the load. Impedance therefore does not determine regulation.

The regulation of a circuit is in general determined by two elements—the counter E. M. F. of the circuit and the self-induction of the load. The drop, or difference of potential between generator terminals and the load terminals due to the counter E. M. F. of the line depends, as has been shown, upon the self-induction of the load. The latter is best expressed by a power factor or a factor by which the product of the amperes and volts giving the apparent energy must be multiplied to give the true power in watts. The power factor for incandescent lamps is 1.00, or the apparent energy is equal to the true energy. The power factors for converters loaded with incandescent lamps is usually over .99. The factor for unloaded converters varies from .50 to .80, and in open magnetic circuit converters, notably the "hedge hog" the factor may be as low as .05. The relations of the drop to various power factors of the load may be elegantly determined by a simple diagram on section paper ruled in tenths. Draw an arc through a quadrant with a radius of 100. At a distance from the centre on the horizontal, equal to the power factor of the load, erect a perpendicular and extend it to the arc. This line represents the counter E. M. F. of the load and its value read directly on the scale gives the counter E. M. F. in per cent of the E. M. F. upon the load. From the intersection of the arc draw a horizontal line outside the circle equal on the scale divisions to the per cent in terms of the E. M. F. on the load which would be required for sending the normal amperes continuous current through the line resistance. From the end of this horizontal line draw an upward vertical equal to the counter E. M. F. of the line expressed in per cent of the E. M. F. on the load. A line from the center to the upper end of this verticle represents in direction and magnitude the E. M. F. which must be impressed on the circuit. If from the same center an arc be drawn through this point to the base, the scale divisions on the base between the two arcs measures the total drop caused by the line in terms of the E. M. F. on the load.

Self-induction exists in line, generators, transformers, secondary wiring, and sometimes in the load. In each case the effect of the self-induction upon regulation depends largely upon the self-induction of the total load which it supplies. Thus, the regulation of a generator depends upon the total self-induction of the line, transformers and load. Again, the regulation of a line supplying converters depends both upon the self-induction of the converters as well as that of the useful load. The same analysis, diagrams and tables which have been used above in connection with the line will apply to the transformers and approximately to the regulation of the generator.

An ordinary transformer has a primary self-induction and a secondary self-induction and a mutual induction which becomes a ready source of very complicated and perplexing analysis when the complete section is described in theoretical terms. Practically, however, the action of the self-induction in the transformer may be expressed in a very simple way, and it is readily seen that this self-induction has a very important bearing upon the regulation of the transformer. The regulation of the transformer is very similar to that of a line, as explained above. If the secondary coil be short-circuited the E. M. F. on the primary may be adjusted so that the normal full load current passes through the apparatus.

(*Paper and discussion concluded in April number.*)

Prof. Anthony, on behalf of the committee appointed on the rating of arc lamps, presented a resolution on behalf of the committee, which after slight verbal changes, was adopted, as follows: Recognizing the difficulty, if not impossibility, of measuring with any degree of accuracy, the illuminating power of arc lamps, and the great necessity for a more precise definition and statement of the obligation of the producer of electricity for illuminating purposes to the consumer thereof, be it *Resolved*, That in the opinion of this convention, what is ordinarily known as a 2,000 candle power arc lamp is one requiring on the average four hundred and fifty Watts (4 for its maintenance,) the measurements being made at the lamp terminus, where no sensible resistance is included in series with the arc. In case such resistance is used it must be excluded in the measurement of the voltage.

(Signed) T. C. Mendenhall, W. A. Anthony, George Forbes, Wm. J. Hammer, Edward Weston.

The President announced the next order of business to be the report of the committee on the "National Electric Light Association's Standard Rules for Electrical Construction and Operation."

The proposed amendments to the rules were read by Mr. W. J. Hammer, chairman of the committee, and after slight verbal changes were adopted as presented. On motion it was ordered that the rules be copyrighted.

The meeting then resolved itself into executive session.

EXECUTIVE SESSION.

Mr. DeCamp, Chairman of the Committee on Nominations, presented the nominations for officers for the ensuing year, as follows: President, N. J. Francisco, Rutland, Vermont; 1st vice-president, C. H. Wilmerding, Chicago, Ill.; 2nd vice-president, Frederic Nicholls, Toronto, Canada.

Executive Committee.—Chas. R. Huntley, Buffalo, N. Y.; A. J. Markel, Hazelton, Pa.; W. W. Carnes, Memphis, Tenn.

Upon ballots being cast the gentlemen were unanimously elected.

A set of resolutions were here presented expressing the esteem and appreciation of the work of Mr. C. O. Baker, Jr., master of transportation in behalf of the convention. The resolutions were ordered engrossed and presented to Mr. Baker.

FRIDAY MORNING SESSION.

The meeting was called to order by President Armstrong at 10:30, The first business was the discussion of the topic "Arc Lights on Incandescent Circuits." The President called on Mr. L. B. Marks to open the discussion.

L. B. Marks: "While the introduction on direct current incandescent circuits has been accomplished with a fair degree of success, the waste of a large percentage of energy in 'dead' resistance is always involved with a single arc across such a circuit, the loss of energy due to resistance in series, may be from fifty to sixty per cent.; with two arcs in series across the mains the loss may be reduced to about twenty-five per cent. On 110 or 120 volt circuits economical conditions require more than one arc lamp across the mains.

"During the past few months Mr. C. Ransom and myself have been engaged in the development of what we believe to be an entirely new idea in arc lighting. I refer to what we have called the high potential incandescent arc. I have found that when the electric arc plays in an atmosphere of 00 gas, the usual relation of current, P. D., and maximum efficiency for an electrode of given diameter does not hold.

"By confining the arc in a very small bulb, filled with carbon gas, we have been able to efficiently reduce the current and greatly increase the P. D. For instance: with a pair of electrodes, which in the open air arc light, give a maximum efficiency at nine amperes and 50 volts, we have obtained excellent results at 4½ amperes and 100 volts—a condition impossible in open air arcs.

"We have had no difficulty in running 100 to 120 volt arcs in this way, the current in each case being very small. The bulb we have used for the purpose is a modified Howard cylinder, containing a special device for controlling the inclosed gas.

"When operated under these conditions the arc is about half an inch long and very steady. The violet hue so common to open air long arcs is not marked, the quality of the light being especially valuable for in-door illumination. The life of a pair of $\frac{7}{16}$ inch carbons in a 500 Watt lamp is about 100 hours.

"The application of this system to incandescent circuits and its advantages over the present method are apparent. It dispenses with the necessity of running two lamps in series, a single arc without appreciable dead resistance being sufficient to bridge the mains.

"It will be noted that the consumption of carbon is so slow that even if the points are fixed, the P. D. between the electrodes will not increase more than a few volts per hour. The comparatively rapid consumption of carbon in open air and the consequent changes in resistance and candle power of the arc, are in marked contrast to the above, and suggest an important advantage of the inclosed arc for constant potential circuits.

"In the lamp which we have constructed for our purpose, we have two regulating coils differentially wound on the same core, and in series relation to each other, one coil being in series with, the other in shunt around the arc. By properly proportioning the coils we have obtained a very sensitive feed. Summarizing, the advantages which may accrue from the use of the high potential lamp on incandescent circuits are as follows—(a) saving in energy; (b) saving in cost of trimming; (c) saving in carbons; (d) improvement in the quality of the light; (e) subdivision of the light; (f) cleanliness, no carbon dust or soot; (g) perfect spark arrester.

Mr. Barstow, of Brooklyn: "At the suggestion of your honored secretary I have gathered together a few facts in regard to arc lamps operated on incandescent low tension system. The low tension arc lamp was four years ago in much the same position as it was until recently the alternating current motor, for while they were both practical it remained to be shown by actual practices on a large commercial scale that difficulties would not arise which would prevent their perfect success with the public.

"As the history of low tension arc lighting began on the system of the Brooklyn Edison Co., I will simply give you as concisely as I can the advantages and disadvantages which have actually developed in commercial practice. The first disadvantages (in which we were immediately interested) were: 1. The requiring of a load resistance in the circuits of the lamps which ment lost energy. 2. The requiring for commercial reasons of the installation of lamps in pairs.

"It will not be denied probably by any of us here that a low tension direct current system can easily manufacture current cheaper by employing large units operating in multiple than can a high tension system with its larger number of small machines. There is today in this country a large company operating arcs on both high and low tension systems and they have assured me although they are wedded to neither system that it costs them 25 per cent less to manufacture current for their low tensions than for their high tension arcs. This is taken from actual results of the past year. With this condition before us we can easily see that we can well afford to waste 10 per cent of energy on our low tension system outside of our station especially when the customer pays for it. The question of desirability of installing lamps in pairs must be answered by the customer and in Brooklyn the results will warrant a strong affirmative.

"In making a price for current for low tension arc lamps there must be taken into account of renewals the renewal of the lamp resistance which will of course decrease in value as better methods of resistance are introduced. In order to get the same price for an arc current as for an incandescent current, which of course comes from the same generator, the price of current per 16 c. p. lamp hour was taken as a basis. It was then found that 9 cents per hour for a 1,200 c. p. arc lamp current corresponded with 8 cents per hour for equivalent incandescent current, as the proportion of arc lamp renewals exceeded the incandescent. As the cost of labor in trimming an arc lamp is the same whether the lamp is burnt for one, two or six hours, it was found that in order to be fair in a meter rate a sliding scale should be used. Therefore, a scale commencing at 9 cents per lamp for the first hour and decreasing in proportion to the length of burning was adopted. It was further thought that if customers paid for current actually used without reference to the number of lamps installed and the company was to loan the lamps there would be no limit to the number of lamps asked for, while the customer would not bind himself to use all of them. This difficulty was easily settled by grading the discount price of current according to the lamp average hours per day, which was obtained by comparing the total current with the number of lamps installed.

"The first pair of arc lamps were installed in Brooklyn in the spring of 1890 and since then the progress has been very rapid, which can readily be seen in the fact that to-day we are operating almost 2,700 lamps with orders ahead for some 400 more—and now as to actual results.

"It has been practically shown that our fears in regard to low tension arc lamps as regards the two disadvantages mentioned above were almost without actual foundation, and that we can today furnish lamps as cheap as our high tension competition and still make as much profit as on our incandescent installation.

"I will submit to you a complete report on arc lamps for the year 1893, which will show more clearly the defects which we are now correcting—and almost all of these occur in the high tension system, and as I have not accurate data on the latter I am unable to draw any camparisons but will leave that for you to do.

Number of Ward lamps in use	2,246	
Number of Bijou lamps in use	400	
Total number of complaints	3,911	
Defective carbons	2	per cent.
Retrims	7	"
Defective adjustment	12	"
Fuses and plugs blown—unknown cause	10	"
Loose connections caused by storms	6	"
Trouble with mechanism of lamp	12	"
Carbon holders broken and burnt out	1	"
Lamps grounded external	8	"
Defective cleaning	16	"
Defective house wiring	2	"
Resistances burnt out and grounded	5	"
Defective installation	1	"
No trouble when man arrived	10	"
Special complaints	8	"
Total number of trimmers	17	
Average number of lamps per trimmer	144	
Maximum number of lamps per trimmer	170	
Maximum trims per trimmer	182	

"Labor and material for repairing, repainting, rewinding, resistances, and changing lamps, including testing of all new lamps—75 cents per lamp per year.

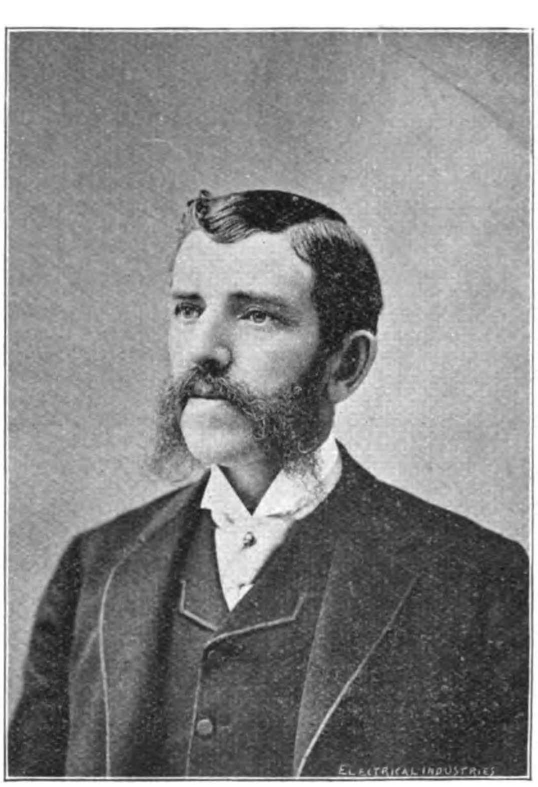
"Globe renewals exclusive of those paid for by customers—7 cents per lamp per year.

"We are now working on a system of carbon renewals, which plan though not a novel one has not been in actual practice sufficiently long to warrant actual data."

The next topic "Meters vs. Flat Rates," was opened by Mr. Frederic Nicholls, who said: "In my experience nearly every company supplying current on the flat rate principle are not furnishing lamp renewals free. In that case you will find that in nine cases out of ten the customer will purchase a low efficiency lamp and consequently the central station manager is furnishing from twenty-five to fifty per cent more current than should be furnished if he had the right to say what kind of a lamp should be used. In the meter system, of course there is more or less conflict with customers as to the amount of current used."

Mr. Scott: "I think in dwellings it is good to have a meter but I think it is more satisfactory to have a flat rate for stores. We know the hours required for lighting, we know the number of lamps necessary, and I have found that the merchant is usually satisfied with a fixed charge whereby he can guage his running expenses. In small stores, using one, two, or three lights I would not allow a meter to be used."

Mr. Carnes: "We have tried both ways; we have tried the flat way and now we are trying the meter; and we have recently made a rule that we will not put in a light except by a meter. I will give you one point to show how it worked with us. We had all we could do to carry what light we had to furnish, we have an alternating capacity of 7,500 lights carrying 15,000 lights. With the meter system we are now able to handle our customers with perfect satisfaction."



MR. M. J. FRANCISCO.

The Convention here adjourned into executive session. In executive session the report of the secretary and treasurer were read, which showed between 30 and 40 new members had been gained at this meeting.

Mr. M. J. Francisco,

The newly elected president of the National Electric Light Association has been a familiar and prominent figure in its gatherings for a number of years. As president and general manager of the Rutland (Vt.) Electric Lighting Company, the principal lighting company of that city, he is throughly conversant with the commercial side of electric lighting and well understands the needs of the industry. He has been a champion of the opponents of municipal lighting plants and is the author of a book on that subject. He brings to the presidency of the association an experience extending over the history of the industry, an experience that has been enlarged by a study of business problems and conditions.

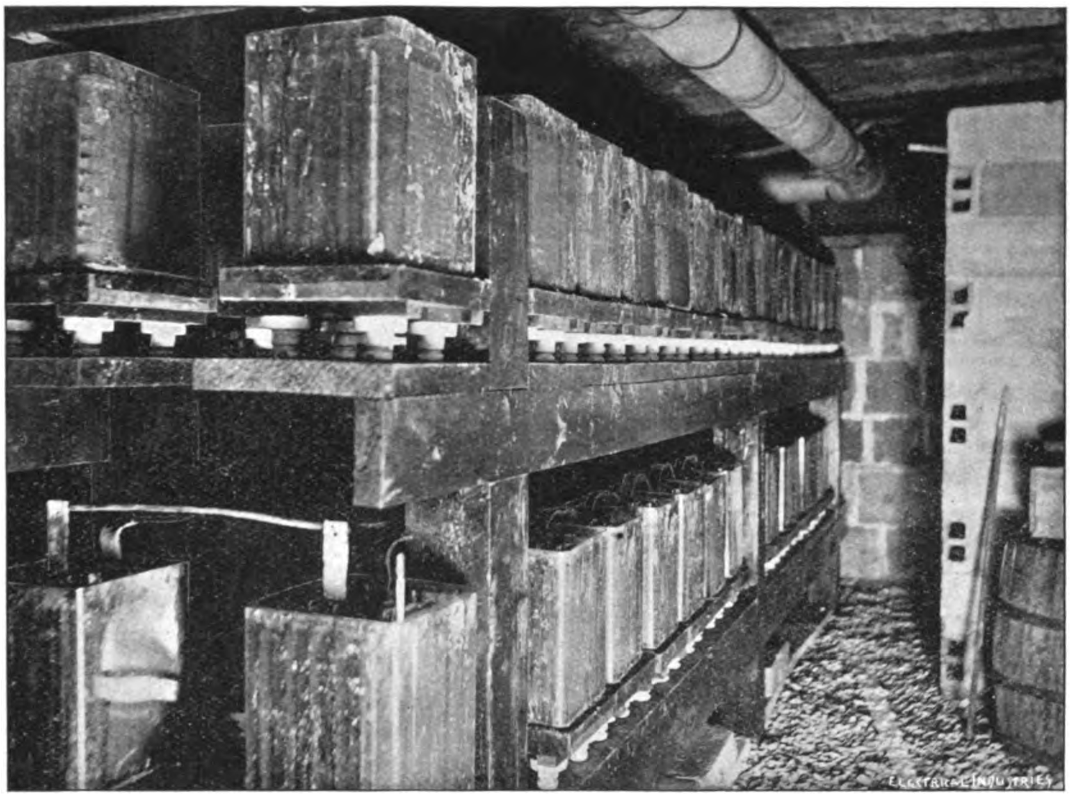
Storage Batteries in the Masonic Temple.

There is no doubt that at no very distant date the storage battery will occupy an important place in the utilization of electric energy. As the capabilities and limitations of the storage battery are more fully understood and knowledge of its use is more widely disseminated, the position it should occupy will open up to it. There are a number of places where the storage battery is now used to advantage and others, which at present are but experiments, will soon be placed on the list.

A large proportion of the office buildings erected in Chicago during the past few years are equipped with their own electric lighting plants. In these buildings lights are required in considerable number until late in the evening, after which only such lights as the janitors and watchmen use are required. To keep steam up and operate a dynamo would involve a large expense proportionate to the service. To supply these lights, storage battery plants have been installed in several buildings which are charged during the day or in the early evening in connection with the operation of the large amount of machinery required in such buildings. The battery plant supplies current for the lights until such a time as it may be necessary to start the dynamos. They require no attendant while in use so that after the machinery is shut down, the owners are under no expense for engineers or attendants.

A storage battery plant for the purpose similar to the above has been installed in the Masonic Temple by the American Battery Company of Chicago. It is used for lighting the basement and the darker portions of the building during a part of the day and after the machinery is shut down at night. From 25 to 100 lights are thrown on the battery the latter number being but seldom required and then only for a short time. The battery consists of 58 cells connected in series, all of which however are not used all the time, a few extra cells being kept ready should it be desirable to change a cell or should the battery be nearly run down and more cells be required to keep up the voltage. A separate room is provided for the battery which is arranged on a substantial frame in two tiers, the fame is insulated from the ground by heavy wooden blocks and the individual cells are insulated by porcelain supports. The cells are in glass jars of more than the usual size. The capacity of each cell is 350 amperes at a 25 ampere rate. The cell is 9¾ by 9 by 13½ inches and weighs 130 pounds. The plates are separated by hard rubber insulating bars or combs which keep all plates the proper distance apart. The plates are manufactured in the manner pursued by the American Battery Co. The jars being much larger in proportion to the plates than usually employed, a much greater amount of solution is held where it can be called upon if needed in charging and discharging the cell.

The battery is charged from a Mayo iron clad dynamo at 140 volts having a capacity of 65 amperes. The dynamo is belted to a friction clutch pully on one of the main shafts in the engine and dynamo room and is usually started soon after the other dynamos. The battery is put into use at 12 o'clock, midnight and is in use some days as late as 4 o'clock the next afternoon, the time depending on the weather and the load carried. One of the first accidents in the history of the building occurred since this battery was put in. The accident extinguished the lights in the building and the current from the battery furnished light while the trouble was being found and repaired. Its use on this occasion saved a great deal of annoyance and permitted the quick repair and starting of the plant.



STORAGE BATTERIES IN THE MASONIC TEMPLE.

The basement of the building is being fitted up for several firms who will occupy it for restaurants, safety vaults, etc., purposes which will require a much larger amount of light than at present. To carry this load after midnight and during the day the storage battery plant will probably be increased. To persons interested in the practical use of the storage battery a full and complete report of the operation of this plant will be full of interest.

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CORRESPONDENCE, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

ADVERTISING RATES upon application.

ONE of the most pleasant as well as instructive features of the convention was the lecture Wednesday evening, February 28, by T. Commerford Martin and Luther Stieringer entitled "Electric Lighting at the World's Fair and Some of its Lessons." The lecture was profusely illustrated by stereopticon views prepared for the occasion. It was given in Grand Army Hall and nearly every seat was occupied, the admittance being by invitation.

THE paper read by Mr. J. H. Vail at the convention on "The Importance of Complete Metallic Circuits for Electric Railways" and the discussion that followed throws considerable light on present practice. This is undoubtedly one of the most important questions that is before the managers of electric railways. It is a subject which is also being carefully considered by telephone and telegraph companies and every user of the earth in the construction of any system of distribution. In the city of Chicago some time ago Prof. Barrett made a careful study of the question and published a report containing the results of his investigation. During the time when he was collecting data and also since his report was made public he received a great many letters from various cities of the country where electric railways were in use and in each one the letters showed that the question was receiving an equal amount of attention. In considering further extensions of the railway systems in our cities this matter is being brought to the attention of the city officials and on that as a basis such extensions are opposed. As it therefore affects the growth of the industry it must be grappled with and such methods employed in the construction of our railways as will overthrow these objections. The experiences of the coming year as presented at the next convention will probably bring us nearer to a solution of the problem as this convention has pointed out the way.

THE Seventeenth Convention of the National Electric Light Association held in Washington, beginning Feb. 27th, can be said to have fully come up to the expectations of all those fortunate enough to attend. Holding the convention in this city and away from the home of the president was a departure and the wisdom of having selected Washington as the place for the meeting was more than confirmed by the large attendance and the interest manifested. There was perhaps more than ever a noticeable absence of exhibits but this feature was more than made up for by the interesting papers and discussions had at the various sessions. A large number of ladies were in attendance and their presence contributed largely to the pleasure of the occasion. And they all expressed themselves as having had a thoroughly enjoyable time. No general entertainment was provided for the delegates but theatre parties and excursions to various points of interest constituted features that were greatly enjoyed. Probably, however, at no former convention has there been more interest or more real benefit derived by the central station man than at this meeting. The giving out of live topics for discussion was a departure, and a good one too, judging from the great amount of interest shown and the number taking part in the discussions. This we believe is in the right direction and will, we hope, be followed in future conventions, as much practical information and data is thus brought out that cannot fail to help the central station owner and manager. The papers read were of importance and form a contribution to electrical literature that will prove valuable to the practical worker in the field. The paper by Mr. C. F. Scott on "Polyphase Transmission" was listened to with great interest and was probably the paper of the convention. The abstract of this paper published in another column, together with that of Mr. A. B. Herrick, on the "Development of Switchboards for Modern Central Stations" and "Importance of Complete Metallic Circuits for Electric Railways," by Mr. J. H. Vail, will be read with interest and profit.

THE lamp situation at the present time is as it will unquestionably remain for some months. The injunction against the Novak company has caused that company to close its factory and another company, whose claim to non-infringement is based on a similar feature, has ceased to manufacture lamps of that kind. The result of the suit against the Davis Electric Company, which was a great surprise to nearly every one, has settled the question of repairing incandescent lamps and it can now be done only under license from the owner of the Edison patent. The Columbia factory in St. Louis is turning out several thousand lamps per day as is also the Buckeye factory at Cleveland. The Westinghouse company expects soon, it is reported, to turn out lamps from its own works of greater durability and at a cost even below the present best wholesale figure.

THE duties of the stationary engineer are constantly extending. Especially is this true in manufacturing establishments and the large buildings of our modern cities. From the care of the engines and the supervision of the firing of the boiler furnaces his duties have increased until what at one time constituted his entire work now forms but a smaller part of it. With the elevators came the elevator machinery, the system of steam heating brought the care of the equipment. As the height of the buildings increased additionl means of supplying the building with water were put in and the care of the pumps and reservoir with the water system come under his care. With the introduction of incandescent electric lighting and the installation of isolated plants a new type of machine came under his supervision. Thus if he has kept pace with his duties he has become familiar with each new piece of apparatus that has been placed in his charge until he has now mastered the entire equipment. He should be thoroughly competent to superintend the repair of the different kinds of apparatus and should understand the most economical method of operating. He should understand the theory and method of constructing the dynamo and be thoroughly posted regarding their care and operation. The position requires a man of intelligence; one who knows what he is doing and able to do it as well as to superintend the work under him.

The Importance of Complete Metallic Circuits for Electric Railways.*

BY J. H. VAIL.

In the early days of electric railway construction two distinctly different systems were devised and competed for public favor. The one being the overhead double trolley system, affording a complete metallic circuit for the out-going and return of all the electric current required to move the motor cars, and the other being the single trolley system, using the track and earth as a common conductor for one side of the circuit, and the trolley wire and parallel mains for the opposite side.

The double trolley system was found impracticable of operation in many of its details, and the single trolley, because of its simplicity and convenience, has made rapid advances in public favor. The single trolley system has depended largely upon the earth and buried pipe systems for completing the circuit. Many devices for making the track and earth combined a more complete and low resistance circuit have been resorted to, such as burying copper or iron plates, old rails or old car wheels, and connecting same to the track; or, at frequent intervals, driving iron rod down in the earth and connecting by wires to track; or by making actual connection with wire from tracks to gas and water pipe systems.

Also, for supposed reinforcement of the track, we have used a bare wire of iron or copper, buried in the earth, laid parallel to the track, and connected at frequent intervals; also the supposed electrical connection of rails at joints, by bond wires of iron or copper, only having a small fractional part of the capacity of the rail as a conductor. In the early days of electric railway construction it was assumed by experts that the earth and the buried pipe systems would, when combined, form an ample return for the electric current. At that age of the art experts did not fully appreciate the immense quantities of current that would require to be carried, and therefore did not foresee that these currents when disseminated would produce the serious results that have been caused by electrolytic action on systems of pipes buried in the earth and owned by other companies. Frequent tests prove that the earth itself cannot afford the free path for the current that was anticipated. Earth conductivity has been overestimated. Iron and lead pipes, being better conductors than earth, must of necessity carry the current, if no superior path is offered by the method of construction. The natural moisture of the earth hastens the destructive electrolytic action of the current on these pipes. In some soils electrolysis is more rapid than in others. The rapidity of action depends upon the chemical constituents of the soil. It has been found that illuminating gas leakage held in such soils as underlie the cities of New York, Brooklyn, Boston, Philadelphia and elsewhere, hasten electrolytic action. Abundance of substantial evidence can be produced. These serve to prove the case, which cannot longer be successfully denied nor assigned to other causes. It has been stated that in an electric railway system where a connection has been made to water pipes, the pipes have carried as much as twenty-eight per cent of the total current. Instances are known where as much as forty per cent is carried on the pipe systems. It is the opinion of the writer that any gas or water pipe system used as a carrier of electric currents will not only be corroded through the body of the pipes, but will surely in due time show defects at joints, as here will occur higher resistance than in any other portions of the pipe system. It has been proven by test that the electrolytic action of even five amperes of current on an iron pipe is considerable, and that much damage will result in one year. The rapidity of action depends upon character of soil, amount of moisture and quantity of current; the destructive action is constant and sure. Any system using ground plates, ground rods or substitutes therefor, or bare return track wire buried in the earth, is constructed primarily to utilize the earth as return circuit; when the earth does not afford good return the current is sure to follow the water pipes, gas pipes or other buried conductors offering the path of least resistance. We now see that these prove to have been only makeshift methods to reduce the cost of construction. We find that the evidence thus produced and the troubles constantly occuring in existing street railway systems are sufficient to show that all methods of grounding the track circuit or connecting to pipe systems should be entirely discontinued; it therefore becomes of vital importance to so construct the electrical railway system as to avoid all electrolytic action on buried systems of metal work that are the property of other concerns.

Having produced the evidence and established the case, let us briefly analyze the matter and ascertain the reason for these results. The whole case may be stated in a single sentence, that the electric current must under natural laws follow the path of least resistance. What was intended to be good has proved to be defective electrical work executed in connection with track systems, has not given to that side of the system a perfect path for the travel of the current; the conductivity of the rail circuit being impaired to such an extent that the electric current must force itself through the earth or through metal pipe lines buried therein. We must here diverge for a moment to show how the incandescent electric light system operated in multiple arc compares with the railway system. An electric railway system may in some degree be compared with a system of electrical distribution for incandescent lighting, the groups of lamps in buildings connected in multiple arc, comparing with each car and its motors demanding current.

The systems otherwise differ in important particulars; the load on the electric light system is not subject to such violent fluctuations as on the electric railway, where the instantaneous demands for current and its equally prompt release must be controlled. The current required for the car is a moving load as the car progresses on its route; this and all other differences of conditions must be duly considered when laying out the system of distribution. With the electric lighting system, the current for consumption is derived from the mains, the equalization of pressure is maintained through the feeders, the mains are of equal capacity on either side of the system. With the electric railway, the track forms one side of the consumption circuit, and must be so treated in regard to distribution of current as to utilize its carrying capacity equally with the other side, and thus equalize the delivery of current. The electric conductors composing a system of distribution for electric railways should be so thoroughly well proportioned as to show the minimum variation of pressure throughout the system, even when the entire number of cars are in operation. This equality of pressure is an important requisite for the economical working of the motors. The writer has tested electric railway systems operating with a station pressure of from 500 to 550 volts, and showing only 300 to 325 volts on various divisions of the system. Here is a direct loss between dynamos and motor car of over *forty per cent.* Is it therefore any wonder that some roads report extraordinary coal consumption? Such loss in pressure indicates radical faults in the original planning of the system and the distribution of copper. When operating under low voltage, the motors demand an increased quantity of current above what should be the normal supply, thus augmenting the heating effect in the armatures and fields, the efficiency of the motors being reduced in corresponding ratio.

A further examination into other features of construction requires some consideration of the bonding of rail joints. The existing methods of utilizing railway tracks for conducting large quantities of current are faulty in at least three particulars: First. Restricted conductivity at joint, due to insufficiency of the rail bonds. Second. Neglecting to properly utilize the track as a conducting medium. Third. Failure to provide a complete circuit of low resistance. For electrical purposes we cannot regard the joint plates and bolts as of any permanent value; the contact is electrically imperfect, the metal surfaces oxydized and under constant movement, due to passing cars pounding the rail joints. The rail sections are in many systems of ample conductivity to carry more than the requisite current, provided they are perfectly bonded and properly connected by feeders with the dynamos. We must, therefore, bond the rail joint in such a *mechanical* manner as to maintain perfect *electrical* contact, and with sufficient metal to restore at the joint nearly the full conductivity as of the rail itself; and at the same time to give the existing joint plates their present freedom of motion.

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*Read before the National Electric Light Association at its 17th convention at Washington, D. C., Feb. 28, 29 and March 1st. Abstract.

It has been found that a system of tract with faulty rail bonds will give a shock to animals and, possibly, to human beings, should the same be brought into actual contact in such a manner as to complete through them the broken circuit. It will be readily understood how difficult it is to maintain proper inspection of the electric bonding where the bonds are covered up by the street pavement. Under such conditions the ground circuit and the bonding escapes inspection until excessive coal consumption, loss of current and other troubles force themselves upon the attention of the street railway management. Observation proves that a faulty rail bond will show its location in winter by heating, due to high resistance, and if snow be present on the ground around the joints the snow is partially melted, thus indicating location of fault. Let us turn our attention for a few moments to the question of the conductivity of the rails.

(According to statement of G. F. Sandt, E. E. which the author believes correct, the area in square inches of a single track of two 56 pound rails is 10.9748, and a single track of two 70 pound rails is 13.7186, while the safe carrying capacity, recorded at one-third that of copper in amperes, is respectively 780 and 976 amperes. The carrying capacity of copper wire between No. 10 B. & S. gauge, and one inch varies between 16 amperes and 302 amperes, the full tables being undoubtedly familiar are omitted.)

These figures serve to show how utterly absurd it is to bond a track of seventy-pound T rails with iron rail bonds No. 4 or No. 0 in size, and to pretend to reinforce their conductivity with a No. 0 iron or even a No. 0 copper wire. It is laying a twelve-inch water main and then putting a one-half inch pipe alongside to help it out. The No. 0 B. W. G. copper wire has a resistance of over twenty times the single track of fifty-six-pound T rails per foot, and the No. 0 B. W. G. iron wire over 112 times the resistance per foot of the same track. How, then, can either of these be of any adequate assistance for conducting current?

The following diagrams indicate the small value of a supplementary wire of either iron or copper when compared with the conductive capacity of a properly bonded single track of fifty-six pound rails. All the areas are in accurate proportion for comparison. Fig. 1 shows the area of a circle indicating the single track of fifty-six-pound rails. Fig. 2 represents the iron reduced to resistance of copper. Fig. 3 shows the No. 1-0 supplementary copper wire and Fig. 4 the No. 1-0 supplementary iron wire reduced to proportionate resistance of copper.

Fig 1

Fig. 2

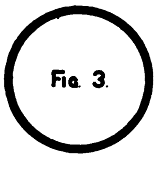


Fig. 3

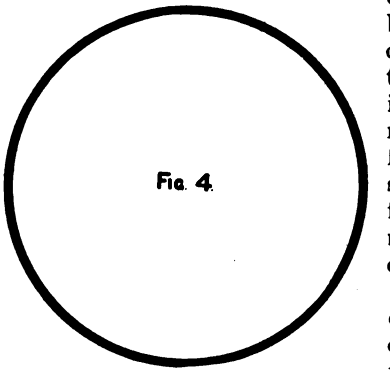


Fig. 4

The writer knows personally of several instances where the copper supplementary wire has absolutely disappeared. The writer believes that ninety-nine per cent of the money expended for so-called supplementary wire is absolutely thrown away. The same money expended in other directions will give more adequate return. Does not this show conclusively that we should give our attention to the more perfect bonding of the rail joints, and also to apply track feeders in such a manner as to fully utilize the conductivity of the track, and thereby make it fulfill the service of which it is capable when properly treated? We are in error when the track system is named as a return circuit. The track system of all electric railways should really be the positive side or outgoing circuit.

It is also important that existing systems of operating electric railways should be promptly taken in hand and the proper remedies intelligently applied. The three-wire system has been mentioned by some engineers as a possible solution. I will here diverge for a minute to state that a trial was made four years ago under favorable conditions—not to avoid electrolysis, but to save copper. We developed physical difficulties of operation which warned us to avoid the three-wire system in future electric railway work. I believe I am safe in stating that ninety per cent. of the electric railways have their systems so constructed as to largely restrict the conductivity of the rail circuit. A one-sided system is fundamentally wrong. The quantity of current to be controlled is so enormous that ordinary make-shift methods will not answer. Having carefully analyzed the whole matter, I feel justified in recommending that we must adopt the complete metallic circuit as the standard for the best electric railway practice. This can best be obtained by the following method: First. By so bonding the track as to render the rail joints of as low resistance and nearly equal conductivity to the rails, and to execute this work so as to maintain this improved condition; and second. The track system must be supplied with insulated feeders leading direct from the bus bars in the station to predetermined points of the track system, and thus offer a perfect low resistance path for this side of the electric circuit, the same as is obtained with the trolley line and the overhead system. All of these features and improved methods have been put in practice by the writer.

The only proper system is one that affords a well insulated and complete metallic circuit of low resistance, that will give an ample path for the complete unrestricted circulation of the entire current from pole to pole of the dynamo, thus offering no inducement for the current to follow such conductors as gas or water pipes, but, as it were, actually robbing the earth of any desire to carry the current. I am not recommending extravagant methods, but only such as are deemed essential for economy, and of a practical nature for reducing expenses and augmenting dividends. The item of cost cannot properly be urged as an objection, because where the whole construction requires a large investment, every detail of the work should be so executed as to be permanent and enduring. If the details are carefully analyzed it will be found that the cost of frequent reconstruction, maintenance and renewals of rail bonds and bare wire amount to an excessive rate of interest on original investment, and would soon pay the small additional cost to build a complete metallic circuit. The superior service obtained from a complete metallic system of low resistance with the proper application of insulated track feeders will, within a brief period, more than refund a reasonable interest on the investment through the saving of fuel alone, not counting other economies in renewals and maintenance. The track feeder system will be far less costly than the double trolley system.

Whether track feeders should be laid underground or erected overhead is a question largely controlled by local conditions and capital available. I express a preference for underground work as being more permanent and subject to the least cost for repairs. The original construction is certainly more costly for underground. The actual cost of copper is the same in either. The necessity of constant repairs, under existing methods, and the damage to water and gas pipes by electrolytic action, simply proves that it is but a question of time as to how long before electric railway companies will be forced to adopt the complete metallic circuit. Where experience and practical knowledge is applied, the cost will not be excessive. It is not difficult to arrive at an exact method of doing the work and an accurate estimate of its cost. The writer has observed on some roads that large quantities of copper for return circuits have been placed at great expense, apparently without a proper conception of how to obtain the best results. Frequently a far less amount of copper, judiciously applied for improved distribution by the feeder system, would give superior equalization of pressure at reduced cost. If for the movement of cars singly or in quantities at a high rate of speed the electric current is to be distributed uniformly over an electric railway system, the subject must be handled with as much scientific accuracy as is always used for a perfect system of incandescent lighting, in order to obtain equal distribution and free flow of current in both sides of the system.

The writer has fully and completely provided for all contigencies in the following manner: First. By a careful study of the conditions under which a system will be operated; these important points being ascertained with reasonable accuracy, the requisite supply and distribution of current for the service is determined, and the system of conductors arranged to meet the requirements. For the proper supply of electric current, the important underlying principles of the feeder system must be thoroughly understood. Second. The conductivity and current-carrying capacity of the track system is calculated, and a system of insulated track feeders is provided, leading from the switchboard in station and connecting at predetermined points, and with a calculated fall of potential.

Each feeder must be determined for its maximum current requirements at a stated drop in potential. The actual work required of the feeder and number of track feeders necessary is determined upon such factors as: The cars in service—their weight, speed and headway; the position of power station and the geographical lay of the railway system; the weight of rails, and whether double or single track, and the amount of load concentrated on sections of track between feeder junctions. The carrying capacity or conductivity of the sum total of all the feeders of the system will be found to give complete and ample circuit for the free flow of the entire current required, and to take care of extra heavy traffic and blockades at any point. The parallel track main is only applied in sections of systems extending over very large territories and long distances.

The conductivity of the rails is calculated with as much care as the over-head system, and when the track needs reinforcing, the purpose is accomplished by laying a thoroughly insulated main line (not a bare line) and making frequent sub-feeder connections bonded to the track. If used at all this main will be of large size. Such a system, accurately worked out, will show by actual test with instruments on the cars a surprising equality of electro-motive force throughout a large territory. A very careful test has been made with instruments on moving cars, throughout a system covering forty miles of streets, with double tracks, equal to eighty miles single track. The readings showed—maximum volts, 512; minimum volts, 420. Average of electro-motive force over entire system, 460 volts, the electro-motive force in station, at bus bars, being 520 volts. The feeders were calculated for ten per cent. drop. The actual average drop from dynamo to motor does not exceed twelve per cent. This will be found to result in reduced fuel consumption, better working of the motors, a most satisfactory reduction in repair accounts, and an improved general economy of the entire system. In the system of distribution secured by the above method, the use of ground plates, rods or other insufficient methods is needless; the current travels only over the paths provided for it, and electrolysis of gas and water mains is entirely obviated.

The Central Station at Zanesville, O.

It is a generally accepted opinion that the citizens of many of the smaller cities take a greater interest and pride in public improvements than those of larger cities. Nothing attracts the attention of a visitor quicker than the method of lighting the streets and upon this point he estimates the business and enterprise of its citizens. It is undoubtedly largely due to the public spiritedness of its citizens that Zanesville, Ohio, has one of the best equipped central stations in proportion to its size in the state. At its inception, however, the persuasive eloquence of the "electric-light-man" probably had more to do with its construction.

The history of the Zanesville Electric Light Co. is not dissimilar to that of many other electric light companies organized about the same time. The enthusiastic promoter who carried such satisfactory proofs of a great bonanza in a central station; the credulous investor; the construction and operation of the plant and the vanishing of the golden dream along with the promoters are shadows common to the history of many companies. With the shattering of the delusion commenced the real progressive history of this central station. The practical knowledge gained in the construction and subsequent operation of the station was put to the best use and the situation was considered from a common sense, business point of view. The company was organized in 1886 and during the following four years the commercial production of electricity was studied and such an amount of valuable experience gained as has been exceedingly useful in the construction and operation of the present station.

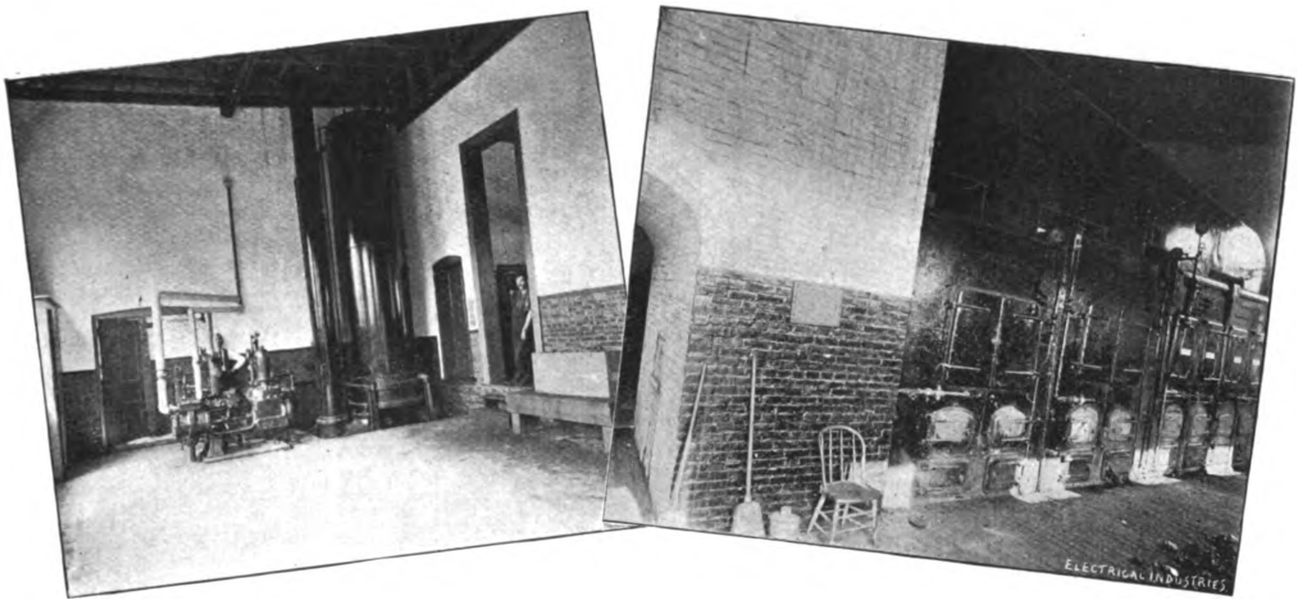


FIG. 1.—THE CENTRAL STATION AT ZANESVILLE, O.

In the summer of 1890 the old station which occupied an old tumble down building entirely unfit for the protection of electrical machinery or a steam plant, was looked over and such pieces of machinery as could be used to advantage in a new plant were taken out. In a new brick building substantially built and arranged in accordance with modern ideas of the needs of a central station was placed new apparatus and such as had been culled from the old. The company this time had proceeded in a business like manner and with a knowledge and experience gained in the operation of the old plant had selected intelligently such machines and apparatus as would best meet the requirements of the station.

In selecting the site of the station a place was chosen on a belt line switch connecting with seven railroads, all of which reach the coal mines of that region, enabling the company to receive its coal at the station without transfer. Foresight in this direction places coal by the car load at the station at the low price of $1.00 per ton. Companies who are paying five or six dollars per ton for their coal will at once realize the advantage in this low price of fuel. The low price of fuel did not deter the company, however, from using the most economical methods in the generation of steam. A 1,000-horse power Berryman feed water heater and purifier was installed as shown in the accompanying engraving, with the necessary pumps for the feed water.

The boiler plant consists of two batteries of four boilers of 100-horse power capacity each. They are of the tubular type, manufactured by the Griffith & Wedge Co. and the Blandy Machine Co. of Zanesville. The engine equipment consists of five engines of 150-horse power each, of which three are Griffith & Wedge slide valve engines and two Russell & Co.'s automatic engines. To these are belted the dynamos which furnish the current for the 370 arc lamps and 600 incandescent, and also four generators of 50 K. W. at 500 volts each which supply current for the Zanesville Electric Railway with which the lighting company has a contract. The arc dynamos and power generators are of Western Electric manufacture and have given perfect satisfaction to the company. The cars as yet have not been stopped through any fault of the generators, the only time being on account of a most severe storm. A remarkable record for a three years run. In order to provide against a stoppage from an accident to the power plant it is twice as large as necessary for the operation of the road and two machines are thus held in reserve.

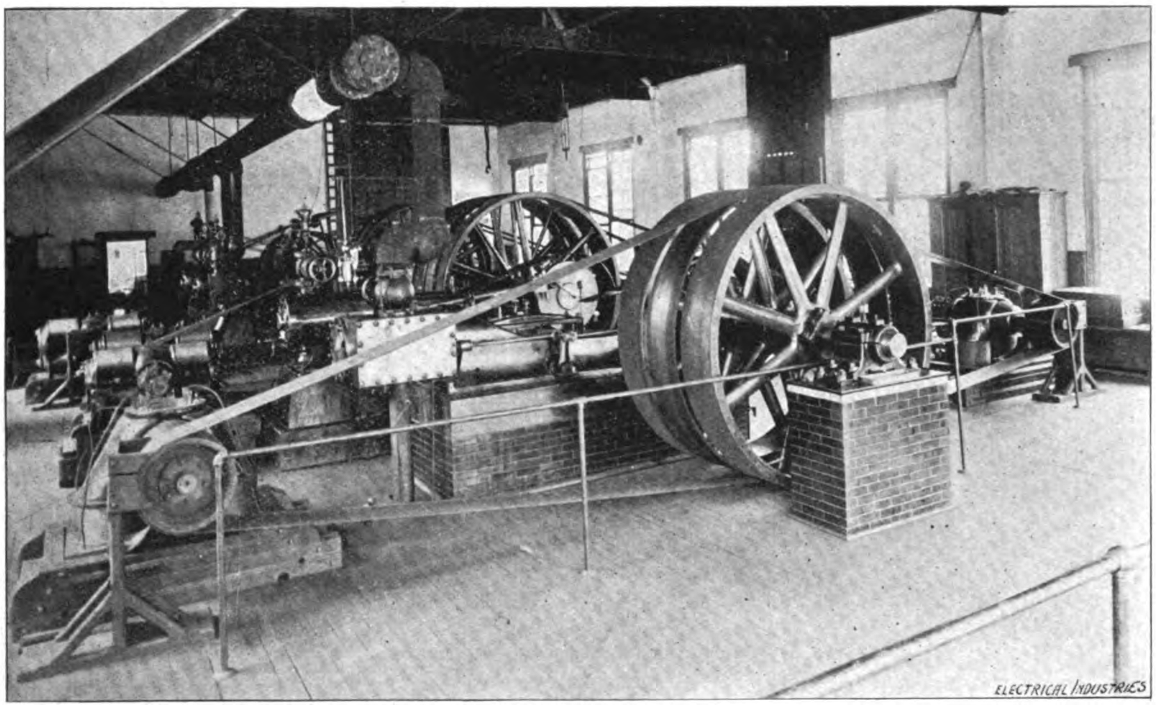


FIG. 2.—THE CENTRAL STATION AT ZANESVILLE, O.

Of the 370 arc lights, which are of the Western Electric type, 175 are street lights run on a moonlight schedule after midnight for which $87.50 is received per year. The balance of the arc lights are commercial and are burned from one hour before sunset till 10 and 12:30, for which rates of $75.00 and $93.00 per year are made for six nights per week. The 600 incandescent lamps are run on the Edison three wire system and rates of 75c, 90c and $1.00 per month are made for these lights or on meter at one cent per hour, the company furnishing renewals. Arrangements are being made to place an alternator in the station for operating the incandescent lights as the present system is considered too expensive, the station being one-half mile from the center of city, for transmission and line. Current is furnished motors ranging in size from one-eighth to two-horse power at 220 and 500 volts to the amount of above 20-horse power for which $8.00 per horse power per month is received.

At the present time the results obtained are satisfactory from a financial point of view, no burnouts or accidents having occured to cause a heavy expense; this is due largely to the experience with the old station, by which they have profited and the business ability of the managers of the affairs of the company. Yet the company believes that considering the dangers that attend the operation of a station of this kind, the liability to accidents either on the lines or station; the rapid progress made in the machines and systems which has made the apparatus short lived, requiring, if the station is to keep pace with the times, renewals every few years, a margin of 25 per cent should be made on the stock but has most serious doubts whether any station can show such profits.

The officers of the company are president, Jno. Hoge; vice-president, R. S. Schultz; secretary and treasurer, F. G. Grace, and superintendent, W. C. Perry.

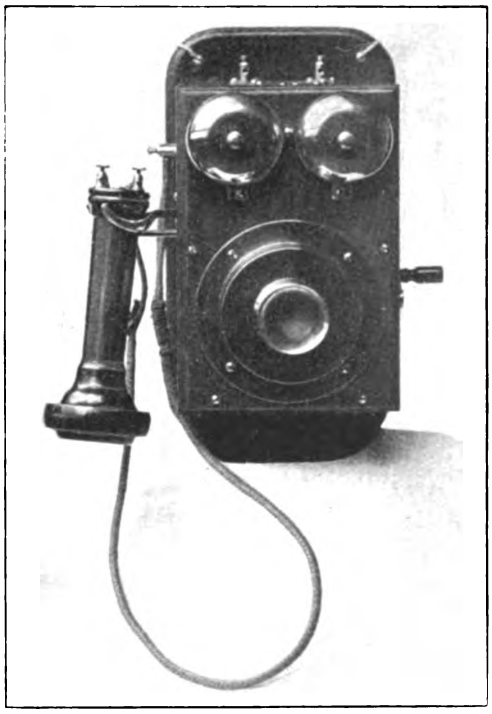
The first annual report of the Western Electric Building and Loan Association shows an average earning for the year of 12 per cent. Such a showing must be gratifying to the officers of the association. It indicates also what can be done in this direction in connection with a large company like the Western Electric Co. The officers are president, C. D. Crandall; vice-president, Jno. Young; treasurer, F. Lancaster; secretary, F. B. Uhrig and attorney, Louis Spahn, all of whom are connected with the Western Electric Company. The dues of the association are fifty cents per share per month.

An Improved Magneto Telephone.

A very compactly made up telephone is shown in the accompanying cut. It is manufactured under patents owned by the Western Telephone Construction Company, of Chicago, which company has recently placed them on the market. The patents of both the Stromberg and Carlson magneto telephones, which were granted September 5, 1893, are owned by this company. Thus the company is amply protected by its own patents, which do not in any way interfere with the patents of the older companies.

While the telephone takes up but little space, it is a highly efficient and strong instrument, as shown by the successful results of the recent long distance tests between Chicago and New York. It requires no battery, and consequently does not need the renewals of that form of telephone. The same magnets that are required for ringing the magneto bell, furnish the current for the magneto transmitter. Short lines operate with equal distinctness with the longer lines.

The great simplicity of this telephone, the ease with which it can be put in use and adjusted, and the small liability to injury, are points of merit that commend it to users of telephones. In this type of telephone the current of electricity is generated by the movement of the plates or diaphragm of the transmitting instrument producing variations in the strength of the magnet, and a current varying in accordance with the vibrations of the diaphragm. This current passing through the coils of the magnet in the receiving instrument, causes the diaphragm to vibrate as the current varies. Thus the waves of sound striking the diaphragm of the transmitter, produces waves of sound at the receiving instrument by means of the intervening magnets, wire, etc. The Western Telephone Construction Company has already a large number in successful use.



AN IMPROVED MAGNETO TELEPHONE.

Mr. A. W. Field, secretary of the Columbus Edison Electric Light Company, Columbus, O., writes under date of February 17: "We are pleased with your journal in every way and use it for station reference very frequently."

New Crocker-Wheeler Multipolar Machines.

The Crocker-Wheeler Electric Company, of New York, has now on the market a new multipolar type of machine. The new works of the company at Ampere, N. J., are turning out a full line of the larger sizes of dynamos and motors of this type. The machines have been carefully designed by the engineers of the company, having been in the designing and draughting departments for more than a year. The machines are well proportioned and substantially constructed.

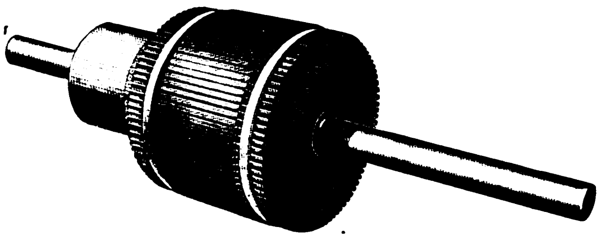


FIG. 1.—NEW CROCKER-WHEELER MULTIPOLAR MACHINES.

The field magnets are of steel turned to gauge and set into the yoke at the proper points. The field coils are wound on spools, and slipped over the pole pieces. The lower half of the yoke is cast in one piece, with the frame base, which gives a firm construction to the machine. The pillow block standards are also cast on this piece so that it is impossible for the armature shaft to get out of alignment. The bearings are of a new self-oiling pattern. Attached to the pillow block is a grooved ring, on which the rocker arm turns. The ring is cut away on the upper side to allow the shaft to be lifted out. The rocker arm is made in halves, and is easily taken apart or put together when the armature is taken out or put in.

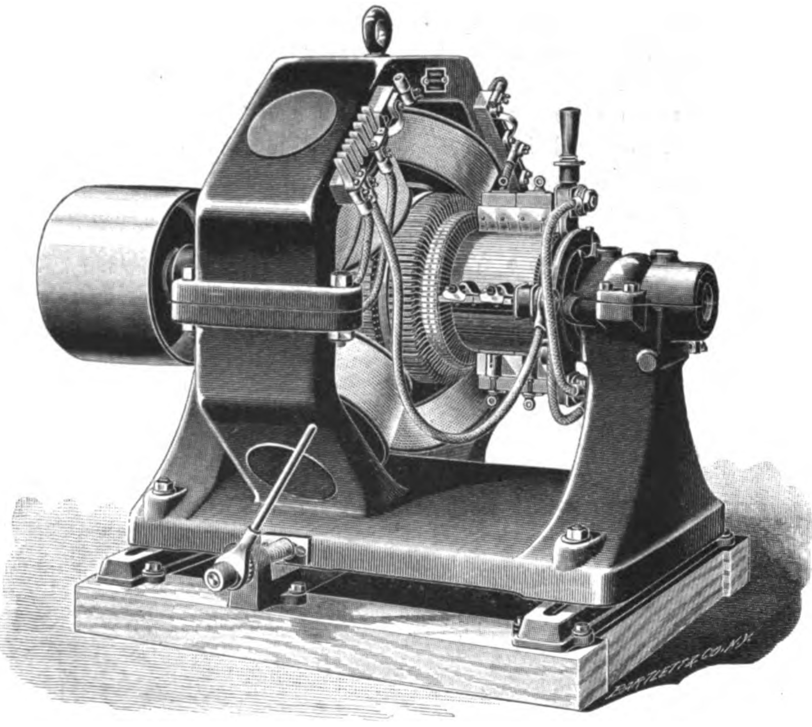


FIG. 2.—NEW CROCKER-WHEELER MULTIPOLAR MACHINES.

The armature for the multipolar type above 25-horse power, 110 volt, has in place of the ordinary ring winding conductors of rectangular bar copper, rivet together by means of strip copper and connectors. The armatures thus wound, although for multipolar machines have but two circuits, and may, therefore, be operated with two sets of brushes instead of four, because of the cross connection within the armature. This form of armature is an improvement on the invention of Mr. C. S. Bradley, used by the old Standard company of St. Johnsburg, Vt., which was succeeded by the Crocker-Wheeler Co. It has many advantages over the old methods for certain types of electric machines which will greatly extend its use. The brush holders, binding posts and contacts on the machine, are of new designs, which have been devised by the company in the endeavor to place a machine before the trade that would in every particular be fully up with the times.

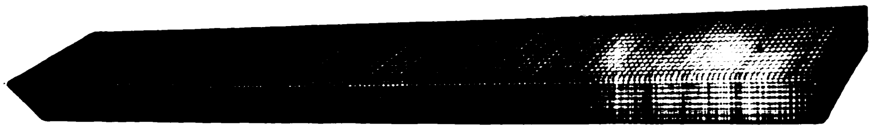
The efficiency of these machines are of a high rate, and whatever losses there are, are evenly distributed over the machine, so that there is no excessive heating in any one part no matter what the load may be. A neat finish is given to the machines, and excellent workmanship is shown in the mechanical construction. The machines are mounted on such bases as the size requires, the larger sizes being mounted on bases which permit it to be moved to tighten or loosen the belt, as the case may be. The company is giving considerable attention to the equipment of power houses and factories where the power is transmitted over larger or smaller areas. Several installations of this kind, one of which required 500-horse power of small motors have been furnished by the company.

Bryant 500 Volt Cut-Out.

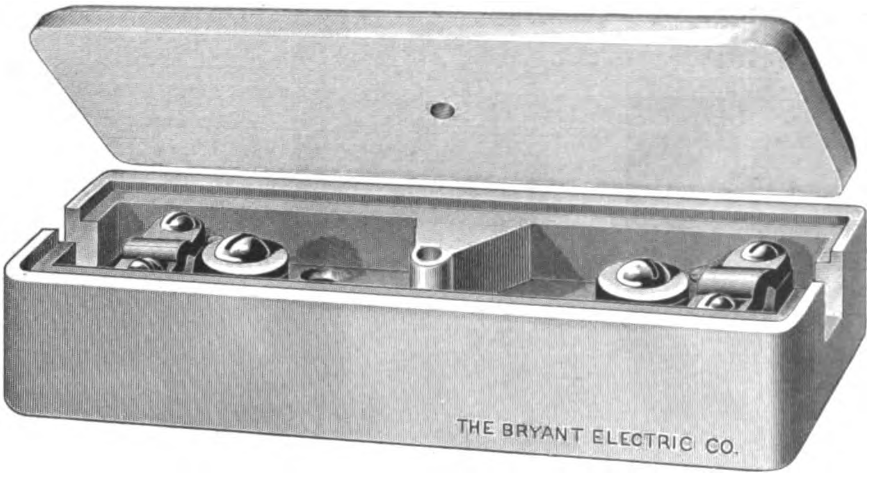
Among the new specialties brought out by the Bryant Electric Co. for 1894 is a 500 volt cut-out as shown in the accompanying cut. It is made of the same procelain as has been used so extensively in other manufactures of the company and is characterized by its hardness and uniformity. This insures a perfect insulation from the support to which it is attached. A porcelain cover securely covers the top preventing a short circuit in that direction should anything be passed sufficiently close.

The terminals which are of brass are securely fastened in the base at a sufficient distance apart to prevent any liability of an arc. A bridge of porcelain which also covers the screws by which the block is attached to the support, is interposed further reducing the liability of a short circuit. The conductor is held between two plates drawn together by two screws giving a firm contact. The fuse wire is held between copper washers which have sufficient area to give a good contact and prevent the wire from being broken in fastening.

The present demand for these cut-outs will undoubtedly soon greatly increase as motors of such voltage become more generally used.



BELKNAP WOVEN WIRE AND GRAPHITE BRUSH.


THE BRYANT ELECTRIC CO.

BRYANT 500 VOLT CUT-OUT.

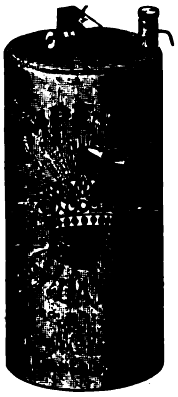
The western office of the company which is in charge of Thos. G. and E. R. Grier has placed them before the western trade.

Belknap Woven Wire and Graphite Brush.

An improved commutator brush has recently been placed on the market by the Belknap Motor Co. of Portland, Me. It is a combination of graphite and copper wire cloth which gives a greater conductivity than pure carbon and a structure that does not wear the commutator. The copper wire is made of selected copper, woven after a special pattern into cloth.

The inner folds of the cloth are treated with a compound of graphite so that as the brush wears, the graphite furnishes the lubrication for the commutator. While the brush has great flexibility it holds its shape and is unaffected by any jars or bending that may occur. The carbon brush has been coming into use for some time on account of the easy effect on the commutators but in this the current is sacrificed, the resistance of the carbon being many times that of copper. In this improved brush both the proper conductivity of the brush and the lubrication of the commutators are secured. In the attachment of the brush no grinding or fitting is required and the stubs of worn out brushes may be used by being worked into the center of the new brush. These brushes have already been tried on nearly every make of machine on the market and very satisfactory results are reported. Electric light and power stations as well as isolated plants and motors find them a very serviceable brush.

The Imperial Dry Battery.



IMPERIAL BATTERY.

Dry batteries have become standard articles of trade for which there is a steady demand. The battery shown in the accompanying cut was placed on the market some three years ago by Mr. Wm. Burnley and since his connection with the Miamisburg Electric Co. of Miamisburg, Ohio, has been greatly improved and placed in larger quantities on the market. The company are confident that the battery is a superior one and are therefore putting it more actively on the market. Of the many excellent features of the battery a few are worthy of notice. The depolarizer used does not become a dead weight or resistance and it is not possible for the battery to deplete itself by using up the depolarizing matter.

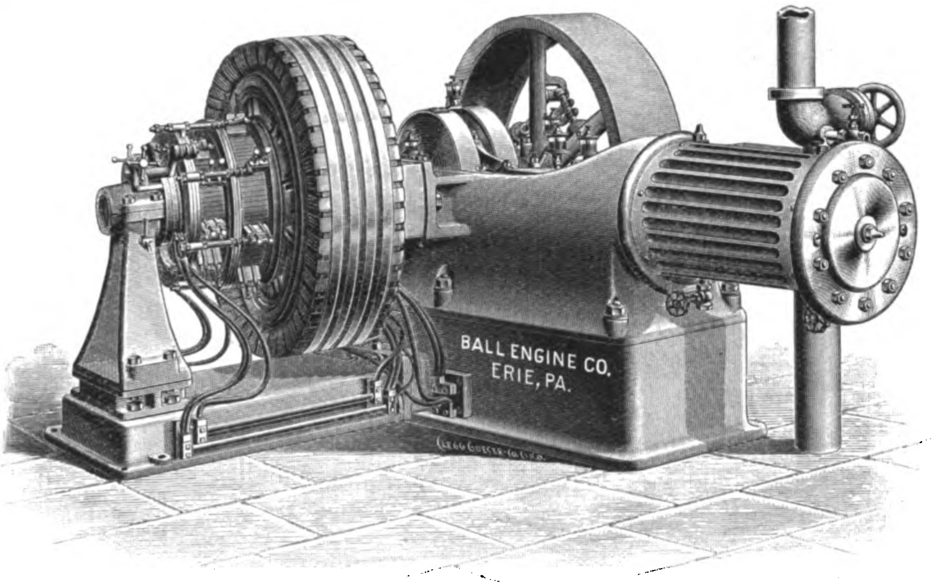
All possibility of short circuits is eliminated. Only when the circuit is closed, is the material consumed and the battery does not deteriorate when not in use. To construct a battery of this kind has required study and hard work especially in securing the latter results from the battery. They are slow to polarize, quick to recuperate and not liable to rapid failure. Hermetically sealed, it continues so and will not boil over or ooze out. The internal resistance has been reduced very small and its E. M. F. remains very nearly constant. Its voltage is one and one-half and amperage from seven to ten. The battery is not intended for a closed circuit battery and should not be used as such. It will meet all the requirements of an open circuit battery. When a closed circuit battery is required or one of large amperage suitable ones are made by the company.

Several evenings have been devoted to the discussion of the telephone at the Well's Memorial Institute, Boston, giving to the subject sufficient time to enter into the mechanical construction of the different parts of the instrument and system. Prof. W. L. Puffer of the Mass. Institute of Technology delivered a lecture on telephone receivers in which that part of the instrument was thoroughly discussed. He called attention to the excellence of many of the new receivers and particularly to the strength and power of the receiver telephone of the National Telephone Mfg. Co.

Ball Engine and Direct Connected Generator.

In the advancement toward the perfect utilization of the forces of nature in the production of electricity many steps have been taken. In working toward this end many lines have been followed, but the practical man has almost without exception endeavored to shorten the distance between the furnace and the distributing switches. The engine and dynamo builders have probably done more in this direction than any other and have therefore delivered in another form the force received with far less loss of power.

The direct connected engine and dynamo has a number of points of advantage. The value of real estate in large cities as well as the lack of room in many buildings, demands compactly built machines which occupy but little room. Central stations and isolated plants in hotels, offices, buildings, etc., are all constructed on more compact plans than formerly. The direct connected engine and dynamo of the pattern shown in the accompanying cut is well adapted for such plants and especially those with low ceilings. Another advantage is the illumination of wastes of energy in the transmission of the power through belts and counter shafting. The frictional losses due to outside causes entirely disappear leaving nothing but the internal friction of the engine.


BALL ENGINE CO.
ERIE, PA.

BALL ENGINE AND DIRECT CONNECTED GENERATOR.

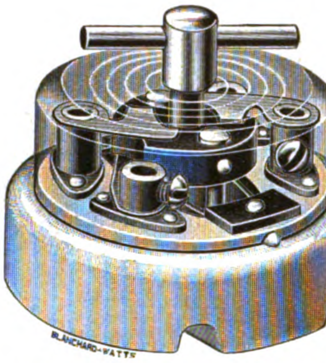
The engine shown in the accompanying cut is an 80-horse power Ball connected to a Waddell-Entz dynamo, which is supported on the crank-shaft, the shaft being upheld by an out board bearing resting on an extended base. A number of installations of this pattern have been made which are giving perfect satisfaction. The combination is firmly mounted on a substantial base; the frame is strong and rigid; the bearings and wearing surfaces are large; the material and workmanship are of the first order, and in the design simplicity and durability are apparent. The combination is well balanced and the regulation is said not to exceed one per cent under varying loads.

The Ball Engine Company at its extensive works at Erie, Pa., has recently built for the plant at the Lumber Exchange Building, Minneapolis, Minn., two 200-horse power engines on which were mounted Siemens & Halske dynamos;

for plant in store of Willoughby, Hill & Co., Chicago, one 125-horse power engine with Waddell-Entz dynamo, and for isolated plant in the building of Cumner, Craig & Co., Boston, Mass., one 80-horse power engine to which was connected a Waddell-Entz dynamo. The success that has attended the use of these machines has lead the companies to advocate these combinations for stations and isolated plants.

New Double Pole Snap Switch.

In the accompanying cut is shown a double pole snap switch which since it was placed on the market some six months ago has worked itself into popular favor. It is manufactured by the Iona Manufacturing Co. of 336 Congress St., Boston, Mass. One of the special features of the switch is that it shows at a glance whether the current or lights are on or off. This is of special importance where the lights are not in sight from the switch and saves many a trip to and from the lights. For boards from which the lights in differents parts of a residence or similar places are controlled a glance at the board tells how many lights are in use.



NEW DOUBLE POLE SNAP SWITCH.

The contacts and binding posts are mounted on a porcelain base which insulates them from neighboring objects. The cover which encloses the working parts is easily removed by unscrewing the neat and substantial handle. All parts of the switch are made to patterns, of first claas material and are thoroughly durable. Arcing is absolutely prevented by the interposition of an insulating disc when the contact is broken.

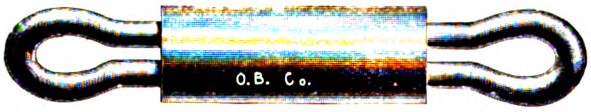


FIG. .1—THE OHIO BRASS COMPANY—STRAIN INSULATOR.

The Ohio Brass Company.

The Ohio Brass Company of Mansfield, O., has recently greatly extended its manufacturing facilities with a view of extending its street railway and electrical trade. The company is not new in the field, having manufactured for several years an extensive line of goods for a large western supply house. The officers of the company are well-known Ohio business men, the president being Mr. E. T. Cook and the secretary and manager, Mr. F. B. Black, while the company is represented on the road by Mr. C. K. King. Mr. King was formerly connected with the Ansonia Electric Co. and has an extensive acquaintance among the street railway men of the west.

The company has a well equipped foundry and machine shop and a laboratory equipped with everything necessary for testing including Riehle testing machines and a line of electric meters and testing sets to make exhaustive tests and measurements of the different articles placed on the market. The company intends to issue reliable reports of tests made on the various articles manufactured including the breaking strain and insulating resistance of each article so that the engineer in charge of a road will have reliable data before him.

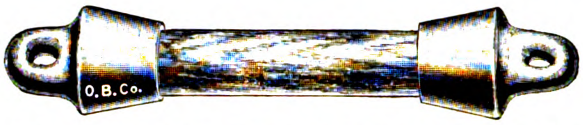


FIG. 2.—THE OHIO BRASS COMPANY—STRAIN INSULATOR.

The accompanying cuts illustrate several of the specialties of the company. In Fig. 1 is shown the Mansfield strain insulator which in the medium size has a breaking strain of 10,000 pounds. It consists of two steel staples five inches long, three-eights of an inch in diameter, moulded into a special insulating compound. It is but seven inches long and weighs but three-quarters of a pound. Its insulating properties are guaranteed under the severest strain.

In the wood break strain insulator, shown in Fig. 2, the hard wood thoroughly seasoned and boiled in paraffine and further coated with a preservative compound furnishes the insulation between the two wires. The metal caps are securely fastened to the wood by a cone shaped wedge inside the cap being forced into the end of the wood and the fibers completely filling the cap so that it is impossible to separate them without breaking the wood.

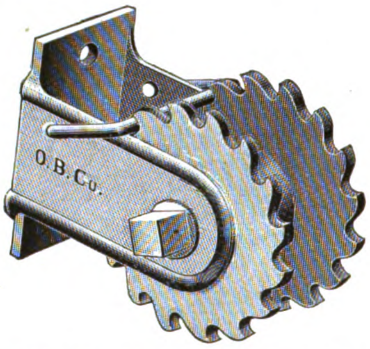


FIG. 4.—THE OHIO BRASS COMPANY—POLE RACHET.

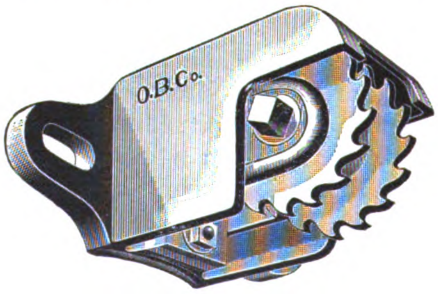


FIG. 4.—THE OHIO BRASS COMPANY—INSULATED POLE RACHET.

A strong and simple pole rachet, known as Wood's self-locking rachet, is shown in Fig. 3. It makes a very light and durable span wire tightener. It is automatic and holds securely the slack as fast as it is taken up. It can be used on either side of the pole with equal success. A malleable iron casing covers the pole rachet thoroughly insulating the span wire from the pole. It is made to strap to the pole, but can be furnished with a hole in the back of the casing for an eye bolt if so desired. These necessary parts of every overhead trolley have been designed after carefully studying the wants of the trade. The simplicity of the different apparatus together with their evident strength and durability are points that should commend them to the trade.

The Winkler Electric Railway Motor and Controller.

The United Columbian Electric Company, of New York, has recently brought out an improved twin series motor for street railways. The company own the patents of Mr. C. F. Winkler, who is the inventor of the equipment. It has been a difficult matter under the different conditions of service to divide equally the load between the two moters, but this has been solved in a very easy and ingenious manner in the new motor, which is illustrated in the accompanying cut.

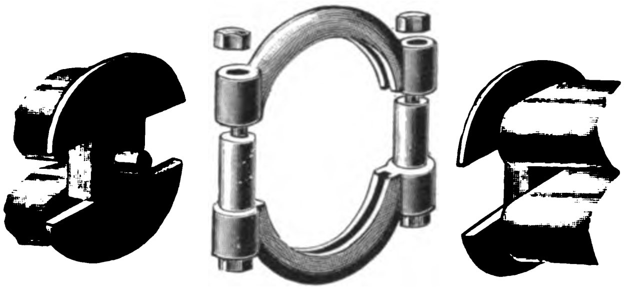


FIG. 1.—THE WINKLER ELECTRIC RAILWAY MOTOR AND CONTROLLER.

But one magnetic circuit or field is used for the two armatures, one of the armatures being geared to each axle. By this arrangement the load is equalized between the two armatures, and as will be seen the motor has the economical advantages of the single motor, while the power is applied directly to both axles. The effects of the magnetic lines of force on the two armatures is exactly identical by the use of the single magnetic circuit,the armatures being compelled to work in unison. This method of construction secures a high efficiency, because as is well known, two motors operated in series with each other are more efficient and can be operated more economically than otherwise, as the counter electro-motive force can be obtained with one-half the number of turns of wire on each armature which means one-half the resistance.

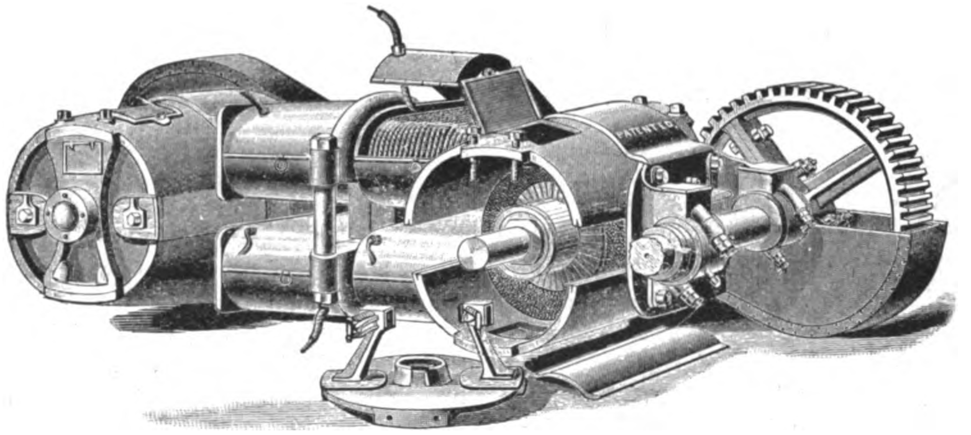


FIG. 2.—THE WINKLER ELECTRIC RAILWAY MOTOR AND CONTROLLER.

A rigid construction of the two motors would necessarily be very hard in its effects on the equipment from the nature of the service which a car performs, but by means of a flexible joint a limited amount of freedom is given to the combination, sufficient, however, to give the necessary play between the axles. This joint is shown in Fig. 1. The motors being bi-polar, can be run with but two brushes without increasing the liability to trouble arising from short circuits between the armature coils.

The motors are of the ironclad type, and while they are fully protected from mud, dust, water, etc., they are easily accessible for inspection. Every part has been skillfully designed. The yokes and supports are of bronze, and all bearings of phosphor bronze. The field coils are wound on spools. The armature is of a remarkable durable form, built up with the wires imbedded in the core after being carefully insulated with mica.

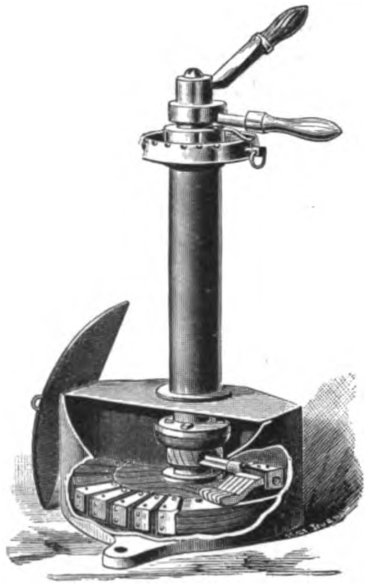


FIG. 3.—THE WINKLER ELECTRIC RAILWAY MOTOR AND CONTROLLER.

In the controller a very compact device is secured, that can all be placed above the car floor, and does not take up any passenger space. All parts are encased within water-tight coverings, which prevent injury of any kind. The reversing switch is operated by an independent lever. The levers cannot be removed without automatically locking the controller. An easy start is secured by cutting out consecutively several slow starting coils on the first few points of the switch. When the car is under way, the speed may be changed by changes in the field circuit. An important feature is the angle at which the contact fingers are set to the contact plates, which prevents arcing between plates when current is thrown from one point to the other.

The entire equipment is carefully planned, and the best workmen and materials are employed in their construction. The factory at Kingston is under the supervision of Mr. Winkler. The motors are in use at Mobile, Ala., and their satisfactory running has brought a recent order for an increased equipment. Mr. E. H. Weller, the general manager of the company, who is well known in the street railway field through his former connection with the Sprague and General companies, reports that six cars are in operation at Kingston, N. Y., using the Winkler motors.

The "Acme" Standard Voltmeters.

The use of the C^2 R losses in any circuit as a measure of the current flowing in that circuit is a well-known method of measurement, and has been incorporated by numerous inventors into more or less practical devices of widely different form for effecting such measurements conveniently and quickly. Instruments of this type possess certain fundamental advantages not attributes of most of the other functions of a flowing current capable of being employed in the operation of measuring instruments. The most important of these is that such an instrument if standardized in any way for direct current measurements will give exactly the same results when used on an alternating circuit, provided, of course, the circuit be wound non-inductively, since in either case the heating is proportional to the mean square of the current flow without other factors entering. Such an instrument, furthermore, can have no magnetic lag, nor can it be influenced by neighboring magnetic fields or circuits since the magnetic quality of its circuit has no part in the operation of the instrument.

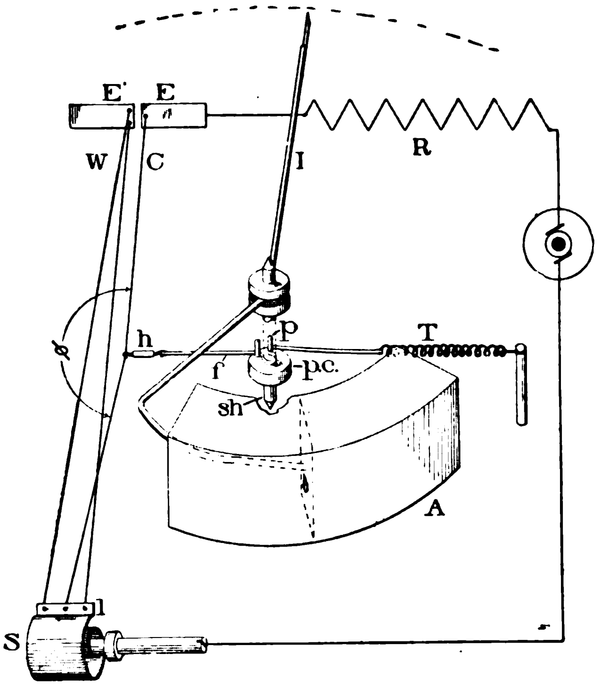
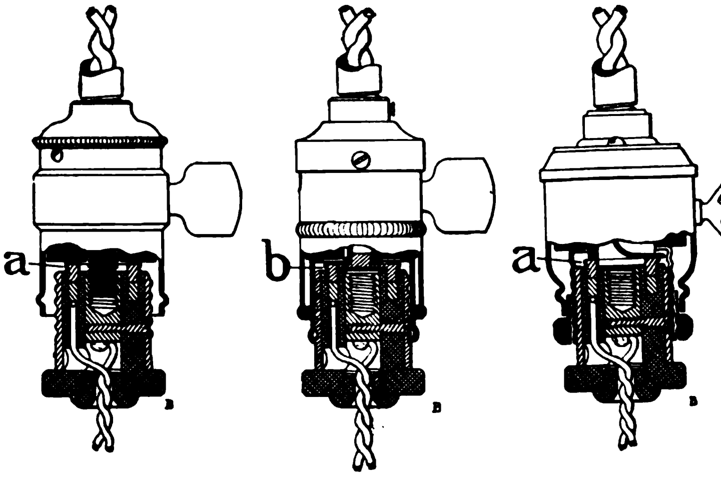


FIG. 1.—THE "ACME" STANDARD VOLTMETERS.



FIGS 8, 9 AND 10.—THE "ACME" STANDARD VOLTMETERS.

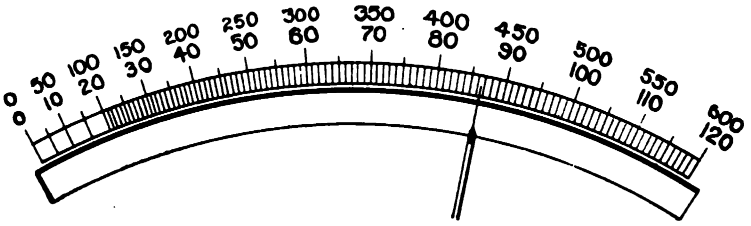


FIG. 4.—THE "ACME" STANDARD VOLTMETERS.

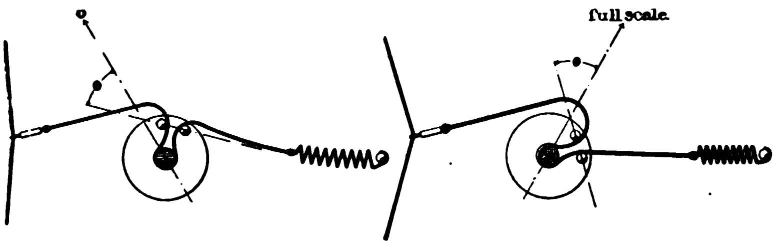


FIG. 2.—THE "ACME" STANDARD VOLTMETERS.

For some years the Cardew voltmeter was recognized as the only standard available for alternating circuits. However, as commercial electricity advanced, it became evident that the Cardew instrument possessed certain defects hitherto unnoticed, and also that an instrument in which these defects were eliminated was urgently required. Recognizing these facts, Queen & Co., of Philadelphia, undertook the study of hot wire intruments with the object in view of developing a more perfect set of instruments. The line of voltmeters is practically complete and includes portable and laboratory instruments of all ranges from 1 to 3,000 volts, both single and double scale; switchboard voltmeters for isolated plants and central stations, with or without illuminated dials, and recording voltmeters of marked advance over existing types. All of these instruments are direct reading on either direct or alternating circuits of any frequency, and are dead-beat in action.

The entire line of "hot-wire" instruments has been designated the Acme series. In Fig. 1 is illustrated diagramatically, the essential working parts of the instrument. The wire C extends from a fixed support, E, to a spirally wound phosphor bronze spring, S. Midway of its length it is connected to the extremity of a phosphor bronze filament or strip, f, which passes around the index shaft, sh, engaging as it goes with two small pins, p; the other extremity of the filament, f, is attached to the spiral take-up spring, T, whose outer end is fixed. It is obvious that for a very small linear expansion of the working wire, C, there will be caused a many times magnified movement of the middle point in line of the filament, f, which movement being taken up by T, results in the carrying of the index I

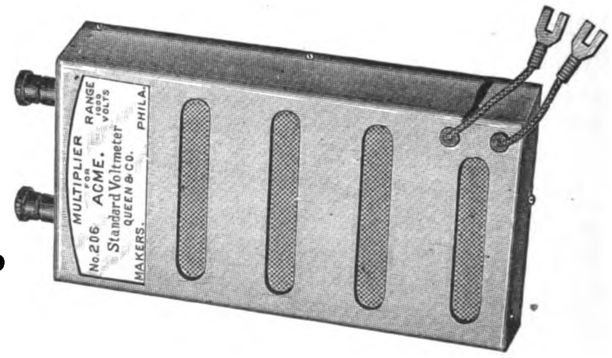


FIG. 5.—THE "ACME" STANDARD VOLTMETERS.

over the scale. The wires, W, are two or more in number, each of the same or nearly the same cross-section as C, and attached at one end to the fixed plate, and at the other end to the spring, S, to which it is attached. These wires, not carrying any current, serve to restrain S from taking up the expansion of C when current is passing, but being affected by general changes of temperature, such as room temperature, etc., to the same degree as C, let out S just enough for such changes to take up the linear expansion of C, due to the same changes, thus preventing any change of zero of the pointer for varying temperatures. It should also be observed that this compensation is effected instantly no matter how varied the changes of temperature since the wires, W, are of the same or nearly the same cross-section as C.

The filament, f, is attached to the wire, C. by means of a minute glass connector, h, provided at each end with equally minute hooks of platinum wire. The purpose of this glass connector is to interpose between the wire, C, and the filament, f, an effective insulation, thus avoiding any risk of accidental short circuits in other portions of the instrument. The platinum hook which engages with the wire, C, is fixed in position by a special cement which holds more firmly the more it is heated.

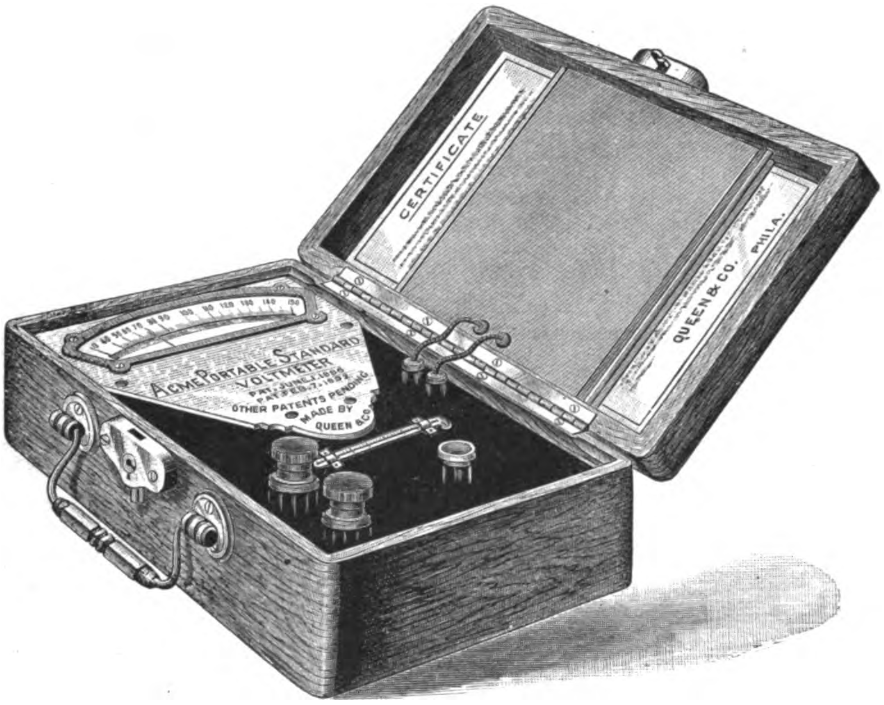


FIG. 6.—THE "ACME" STANDARD VOLTMETERS.

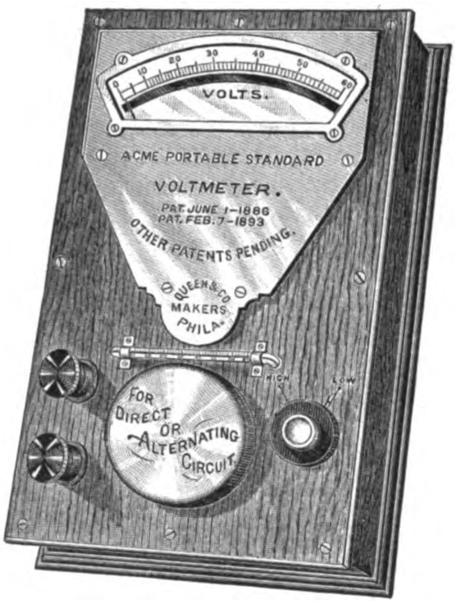


FIG. 7.—THE "ACME" STANDARD VOLTMETERS.

A defect common to previously existing "hot-wire" instruments, and, in fact, to all measuring instruments aiming at any special accuracy has been the difficulty of preventing the instrument from changing its reading or its zero when the containing case becomes strained mechanically in any way, either handling or by the expansion and contraction coincident with general changes in temperature. To avoid any such trouble the entire operative structure of the "Acme" instrument is supported upon a ribbed and very strong aluminum casting which is itself attached to the containing case at but one point. In this way the case of the instrument may be warped or twisted to any extent, even to actually breaking the case in pieces, without, in the least degree, disturbing the indications of the instrument.

As shown by Fig. 1, the working portion of the instrument is the wire, C. This wire is 0.0012 inch in diameter and 6½ inches long; it is drawn from a special alloy of high specific resistance and great tensile strength, and is practically non-oxidizable. It requires to be heated to 150 degrees C, to carry the index, I, over the whole scale and this is effected with 7.5 volts and 1-15 ampere. This wire does not change its resistance for change of temperature, so that to make the instrument applicable to any range of E. M. F. desired, it is only necessary to employ a suitable amount of extra resistance of the same alloy in the shape of a multiplier. To avoid any error being produced by heat, radiated from this extra resistance upon the working wire, the former is thoroughly partitioned off and arranged so that its heat radiation takes place to the external atmosphere.

Fig. 7 shows one of the perfected forms of this voltmeter, being the style intended for inspectors, engineers and others having accurate testing to do in various places. The extra resistance R of Fig. 1, is wound (for all ranges above 75 volts) in sections, in coil form and non-inductively of double covered silk wire thoroughly soaked and baked in shellac. No two neighboring wires can have, therefore, more than 75 volts difference of E. M. F. In order to use as fine a wire for this extra resistance as possible and thus diminish bulk and weight, the extra resistance coil is clamped between two aluminun plates made part of the lid of the instrument as shown, a pair of small flexible leads connecting it with the working wire.

Another form of this instrument, shown in Fig. 7, has been designed for laboratory use and for those engineers who prefer an instrument without hinged lid. In this form the extra resistance is contained in a metal box located between the binding posts and contact key.

One of the principal uses of instruments of this kind is the measurements of potentials at various points in a system of electrical distribution. One of the best methods of connecting the voltmeter to the mains is by means of a socket and plug. To carry plugs to fit the different styles of sockets would be inconvenient so the company have brought out an adapter which can be fitted to any socket.

The manner of its application to the three systems is obvious from inspection of Figs. 8, 9 and 10. In the Westinghouse system, Fig. 8, for example, contact is made by means of an interior threaded nut and a ring, a, this interior nut being joined to the same leading wire as the external Edison threaded sleeve. For the Edison system, Fig. 10, contact is made by means of ring, a, and the regular outside Edison thread. To use this adapter with the Thomson-Houston socket ring, a, is unscrewed and replaced by another ring, b (Fig. 9), similar to a, but carrying above and in its center a square hump fitted to engage the interior contact springs of the socket.

Referring again to Fig. 1, it will appear that the near end of the pointer carries a dasher which moves in an air chamber or dash pot, A. This makes the instrument extremely dead-beat in its action; in fact, almost perfectly so, the pointer not swinging more than the small fraction of an inch beyond its proper position even when the maximum potential is thrown on.

Owing principally to the fact that the elasticity of the take-up spring, T, of Fig. 1, changes necessarily with changes of temperature, the instrument has a temperature correction. This correction is exceedingly small, and is not a percentage correction but a constant for each instrument; approximately 2-10-volt for each 5 degrees F. in a 100-volt instrument and correspondingly greater or less in higher or lower range instruments. This constant must be added to the readings for a rise of temperature and subtracted for a fall of temperature. A thermometer graduated in degrees from 30 degrees F. to 100 degrees F., is placed above the contact key as shown in Figs. 5 and 7, so that this correction can be quickly applied.

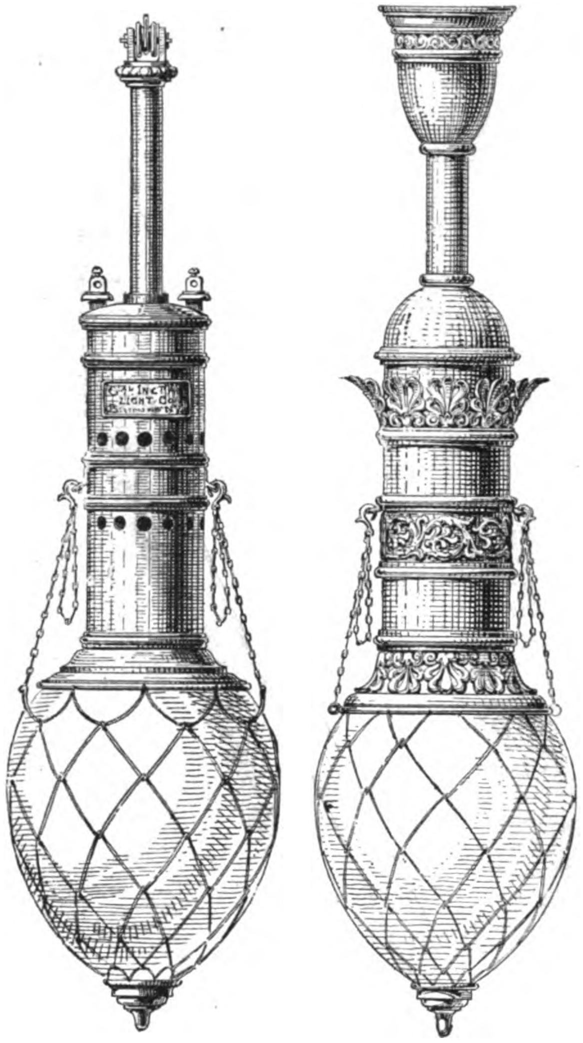
As to accuracy it is claimed by the makers that results can be obtained with this instrument well within ¼ of one per cent on either direct or alternating currents of any frequency.

New Bergmann Alternating Current Arc Lamp.

The recent improvements in the systems of alternating lighting and its more general use has given rise to a demand for alternating current arc lamps to meet the new conditions. With its usual promptness the General Incandescent Arc Light Co. of which Mr. S. Bergmann is president, has brought out an alternating current arc lamp which embodies the latest ideas and improvements both in design and construction. The company's success in the manufacture of the extensive line of continuous current lamp would indicate that the same skill employed in this new lamp would bring a similar result.

The simplicity of the construction, neatness of the design and the skill displayed in the construction of the different parts are a sufficient guarantee of its durability. In operation a steady light is secured which is unaffected by the movement of the regulating mechanism. A smooth and close regulation is secured by the use of very simple devices. The lamp in the various styles is easily trimmed and is protected from both the dust and weather. The lamp has a large range of candle power adapting it for places where either an intense or a mild light is desired. An improved carbon holder is used which possesses several improved features.

The ornamental lamps manufactured in large variety by this company have already greatly extended the field of arc lighting and this new alternating current lamp will be manufactured in ornamental and plain designs adapting it to every place where artificial light is used. In the accompanying cuts are shown some of the designs in which these lamps are manufactured. The company has prepared a circular No. 7, which contains cuts and more detailed descriptions of the new lamp. The designers of the company are also at work on elaborate and novel designs in which the mechanical features of the lamp are entirely concealed within the ornamental outlines.



FIGS. 1 & 2.—NEW BERGMANN ALTERNATING CURRENT LAMP.

At the recent convention at Washington, the lamp was very favorably spoken of by all who witnessed its operation. The members of the convention being men experienced in the use of arc lamps, many of them manufacturers, are able to judge intelligently of the merits of such a lamp and could not be mistaken in their judgment of the lamp.

The Stanwood Manufacturing Company.

The Stanwood Manufacturing Company, Seventeenth and Clark streets, Chicago, which makes a specialty of repairing all kinds of electrical apparatus, has recently secured the services of Mr. Earl Atkinson, whose mechanical and electrical training has been such as few electrical engineers have been able to get. He is in charge of the electrical department and brings to that department an experience and knowledge gained in the employ of the older and more prominent companies of this country. In 1892 he entered the service of the Edison General Electric Company, after having filled the position as foreman for three years of a department in the laboratory of Thos. A. Edison at Orange, N. J., where his skill and activity had attracted the attention of his employer. An early apprenticeship in the engine works of Inglis & Hunter, which he entered at 17, gave him the foundation which has been of great service to him. His apprenticeship and a year were under the direction of one of those old time mechanics who believed in knowing how to do everything thoroughly in the trade. The staff of the company at the present time places it second to none in both ability and experience. Its equipment enables it to repair the most delicate as well as the largest electrical appliances.

CONVENTION NOTES.

The exhibits at the convention were few in number, as compared with other conventions. Through the courtesy, however, of Mr. H. C. Burch, the manager of the Ebbitt House, a room had been fitted up in the hotel for the accommodation of such exhibitors as wished to display samples and light apparatus. Some interesting exhibits were shown.

The Westinghouse Electric & Manufacturing Company, Pittsburgh, made no exhibit of apparatus, but was ably represented by the following named gentlemen: C. A. Bragg, L. B. Stillwell, C. F. Scott, A. J. Wurts, G. B. Humphrey, C. F. Seymour, O. H. Baldwin, Calvert Townley and E. H. Heinrichs. The company distributed some very handsome catalogues and literature, for which it is noted, the latest being a tasty pamphlet on the new direct current series arc light system which it has just put on the market.

The General Incandescent Arc Light Company, New York, showed some handsome samples of central station switches in the exhibition room. At the store of Royce & Marean, the company had on exhibition lamps of its various makes. The company was well represented by Mr. S. A. Douglass, its general sales agent.

The Stirling Company, Chicago, distributed a very neat and convenient pocket memorandum book advertising the Sterling boiler.

The Ries Electric Specialty Company, Baltimore, Md., was represented by Mr. Elias E. Ries, who had on exhibition samples of his well known regulating socket for incandescent lamps.

The Okonite Company, New York, was as usual ably represented by Capt. W. L. Candee and Mr. G. T. Manson, whose familiar faces were everywhere cordially welcomed. The merits of Okonite were not overlooked, it is needless to say.

The Phillips Insulated Wire Company, 39 and 41 Courtlandt street, New York, was well represented by Messrs. H. C. Adams and A. A. Knudson, who had with them samples of the new wire which the company is now putting on the market. Special attention was drawn to the "Ideal" insulated wire. This wire is designed for outside and inside work, and is made fire proof and weather proof. The company had on exhibition a sample of wire immersed in water, through which a current was passing during the convention and lighting a lamp. The exhibit attracted a good deal of attention.

The Interior Conduit & Insulation Company, New York, was represented by Mr. Romaine Mace. He had some handsome samples on exhibition.

The W. S. Hill Electric Company, Boston, exhibited a couple of handsome switch boards and a lightning arrester. The company was ably represented by Mr. G. H. Poor, who distributed a very handsome catalogue recently brought out by the company.

The Hammond Cleat & Insulator Company, Boston, Mass., had in attendance Mr. David J. Cartwright, who showed some samples of cleats and insulators, which the company makes a specialty of. A small memoranda book was given to the delegates.

The Indiana Rubber & Insulated Wire Company, Marion, Ind., showed some samples of its product through Mr. Frank W. Bingham, manager of the eastern sales department, Boston.

The Jewell Belting Company, Hartford, Conn., was represented by Messrs. C. E. Newton and C. L. Tolles, who distributed some handsome printed matter, including a catalogue containing views of installations made by the company in various electric lighting stations throughout the country.

The Hart & Hegeman Manufacturing Company, Hartford, Conn., was well represented in the person of Mr. Alfred H. Pease, who had with him some fine samples of Hart switches. Mr. Pease also had a handsome catalogue which he distributed.

The Standard Underground Cable Company, Pittsburgh, distributed a very convenient new price list. The company also showed a neat sample board containing specimens of wire cable, etc. Mr. J. W. Marsh, the general manager of the company, was present.

T. J. Murphy & Company, New York, was represented by Mr. T. J. Murphy, the president of the company. Mr. Murphy had with him some fine specimens of marbleized slate, also finished in onyx and oak, besides a slate cut-out box of quite a new pattern. He also showed samples of a new combination fastening bolt, and specimens of turned slate.

The Abendroth & Root Manufacturing Company, New York, distributed some circulars and printed matter.

The Bryant Electric Company, Bridgeport, Conn., showed some samples of its well known specialties, including switches, cut-outs, sockets, etc., and was well represented by its president, Mr. W. C. Bryant. The company also distributed some printed matter illustrating its switches.

Mr. Henry G. Issertel, New York, represented the H. W. Johns Manufacturing Company, New York, and the Iona Manufacturing Company, Boston. Mr. Issertel had with him a most attractive sample board containing specialties manufactured by the Iona Manufacturing Company.

Doubleday, Mitchell & Company, New York, had on exhibition some fine specimens of switches for central stations.

The New York & Ohio Company, Warren, O., was well represented by Messrs. W. D. Packard and B. B. Downs, the Philadelphia agent of the company. In the exhibition room the company showed samples of lamps from six-candle power to 500-candle power Moguls. This display of lamps Mr. Packard termed the "Packard family."

The F. P. Little Electrical Construction Supply Company, Buffalo, N. Y., was represented by Messrs. F. P. Little, F. W. Williams and J. F. Kester. The company displayed a direct current lamp in operation. A very handsome alternating lamp was also shown; it was not burning owing to the fact that alternating current could not be obtained. The company also had on exhibition a handsome line of switches for central station work, and besides a constant current lamp intended for 15 hours service. Samples of Kester's compound were also shown.

The H. W. Johns Manufacturing Company, New York, was well represented by Mr. H. G. Issertel. Samples of a new tree insulator were shown, and printed matter was distributed.

The Cutter Electrical & Manufcturing Company, Philadalphia, Pa., was well represented by Messrs. H. B. Cutter and C. E. Bibber. Sample boards showing the specialties made by the company were exhibited, and included push buttons, flexible fixtures, etc.

Pass & Seymour, Syracuse, N. Y., had in attendance Mr. A. P. Seymour, the president of the company, who had with him several new specialties, including a new large arc cut-out made entirely of porcelain, a new china insulating joint, a full line of tubing, water proof sockets, etc.

Queen & Co., incorporated, Philadelphia, attracted attention with their display of "Acme" hot wire volt meters, portable, switchboards and recording types, as also "Acme" portable testing sets, cable testing apparatus, etc. A neatly prepared price list was distributed, which gave full particulars as to ranges, styles of mounting and prices of the voltmeters. The "Acme" Portable Testing Set, samples of which were displayed, attracted considerable attention. The exhibit was in charge of Mr. J. G. Biddle, manager of the electrical depot of the company, and Mr. E. G. Willyoung, electrical expert. These gentlemen were kept busy in explaining the good points of their apparatus.

The Electric Construction & Supply Company, New York, manufacturers of the well-known Ward arc lamp, was represented by Mr. Robt. Corey. As a practical exhibit Mr. Corey called attention to the many of his lamps in service at the present time in the city of Washington.

The Central Electric Company, Chicago, was ably represented by Mr. Geo. A. McKinlock, the president and treasurer of the company. Mr. McKinlock made no exhibit but was kept busy in renewing old acquaintances and making new ones.

The J. H. McEwen Manufacturing Company, Ridgeway, Pa., was represented by F. G. Bowles & Company of Washington.

McDougall, Lucas & Company, Chicago, distributed a little pamphlet descriptive of their Climax iron clad rheostats, motor starting boxes, Kester arc lamps and other specialties, which are handled by the firm.

The Shawhan-Thresher Electric Company, Dayton, O., was represented through its Washington agency, F. G. Bowles & Company who distributed literature of various kinds.

The Consolidated Electric Storage Company of New York and Philadelphia was well represented by its president, Wm. Bracken and secretary P. G. Salom. The company had on exhibition, plates and the other parts of a complete storage battery, of which it is the manufacturer. A pamphlet on storage batteries for central stations, etc., was distributed to all the delegates present.

The Berlin Iron Bridge Company, East Berlin, Conn., had as an exhibit a specimen of its patent corrugated iron roofing, which attracted considerable attention.

The New Haven Insulated Wire Company had in its exhibit a fan motor which attracted a good deal of attention.

The United States Mineral Wool Company, New York, displayed a little card of samples of its corrugated copper gasket.

The American Incandescent Lamp Company had its interests well cared for by its secretary, Mr. Louis Nahm.

The Electrical & Mechanical Engineering & Contracting Company was well represented by Mr. J. H. Vail, who distributed a little pamphlet that was both interesting and instructive.

Geo. Carter & Company, Chicago, had its interests well looked after by Mr. Geo. G. Carter.

Mr. C. S. Van Nuis, New York, was present and as usual had something new to say on the subject of "Ajax" switches, and lightning arresters.

The Falls Rivet & Machine Company, Cuyahoga Falls, O., had its interests well taken care of by its president, Mr. E. L. Babcock.

H. Ward Leonard & Company, New York, was represented by Mr. H. Ward Leonard who presented the merits of a new rheostat.

The Carpenter Enamel Rheostat Company, Bridgeport, Conn., was represented by Mr. C. A. Carpenter.

The Siemens & Halske Electric Company, Chicago, had its interests well taken care of by Mr. Chas. D. Shain its New York representative.

The Stirn Universal Electric Company, New York, had a unique exhibit of its pull socket which attracted a good deal of attention.

The Standard Paint Company, New York, had its interests taken care of by its general sales agent, Mr. Frank DeRonde, who called attention in many ways to the merits of "P. & B."

The Metropolitan Electric Company, Chicago, distributed some intereresting literature calling attention to some of its leading specialties including the famous "P. & B." compound, for which it is the general western agent.

The Columbia Incandescent Lamp Company, St. Louis, had its interests well taken care of by its president, Mr. J. H. Rhotehamel who had a pleasant greeting for his many friends present. The merits of the well-known Columbia lamp were not lost sight of.

The Electric Appliance Company, Chicago, had its interests well taken care of by Mr. Frank W. Brigham, who distributed some interesting literature in behalf of the company.

The Royal Arc Electric Company, New York, was represented at the convention by Messrs. A. H. Patterson and inventor Howard. The new system of this company attracted a great amount of attention and discussion.

The Washington Carbon Company, Pittsburg, had its interests looked after by Mr. J. S. Crider.

Chas. Munson Belting Company, Chicago, was represented by its president, Mr. A. Groetzinger and Col. J. H. Shay.

The Backus Motor Company, Newark, N.J., was represented by its Washington agents, Royce & Marean.

The General Electric Company, New York, had in attendance some of its most able men, including Messrs. S. Dana Greene, A. D. Page, Chas. B. Davis, T. Beran, Wilson L. Howard, A. B. Herrick, F. C. Todd and one or two others, all more or less attached to the lighting and lamp departments of the company's business. Although its supply department made no special display of any of the novelties it has recently brought out, there were, however, several of the new Thomson '93 arc lamps for incandescent circuits burning in front of its Washington agency across the street from the Ebbitt House. The simplicity of the lamp mechanism excited more than ordinary interest. The supply department showed also some of the new arc and railway watt meters, constructed on somewhat similar lines to those of the well-known recording watt meters and which worked with a precision and perfection which must have been to the central station man. In conversation with the representatives present it was learned that the company is especially busy in its railway motor and generator departments as well as meter and arc lamp departments at the present time.

The Belknap Motor Company, Portland, Me., was well represented by its president, Mr. Geo. W. Brown.

Chas. A. Schieren & Company, New York, the well-known manufacturers of belting, had its interests well taken care of by Messrs. Chas. A. Schieren, Jr., E. P. Atkinson and G. H. Fisher.

The Love Electric Underground Railway Company, was represented by its president, Mr. A. G. Wheeler and electrician, Mr. M. D. Law.

The Brush Electric Company was well represented by its general manager, Mr. S. M. Hamill.

The Buckeye Electric Company, Cleveland, O., had its interests well taken care of by Mr. Geo. R. Lean.

E. S. Greeley & Company, New York, had present at the convention its enterprising representative, Mr. F. A. Magee. General E. S. Greeley, the founder of this house, which is the oldest in the United States, was also present.

The Mather Electric Company, Manchester, Conn., was well represented at the convention by its vice-president and general manager, Mr. Thos. C. Perkins. Mr. Perkins received many congratulations on the fact of his company having re-entered active business in the electric lighting field.

CORRESPONDENCE.

Letters From Practical Men.

Editor Electrical Industries: I have been having some trouble with the commutator of one of the generators that I have in charge. One of the segments seems to be soft in spots, so that at one end it wears down very fast, much faster than any of the others. Do you think it would pay to take the commutator apart and put in a new piece, or would it be cheaper to let the commutator wear out and then get a new one? The soft place in the commutator has worn this way ever since the machine was started. Please give me your opinion about fixing it; as they say it would cost more than it is worth to put in just one piece, for the commutator would have to be taken apart and new mica put in all around and then it would have to be put in a lathe and turned down true which would cost too much, as we have no special tools with which to do the work. D. C., Sterling, Ill. 11

The trouble you describe as being soft spots in the commutator is probably due to other causes. You will probably find that the terminal of the armature section which is fastened to that particular segment is loose at that point, or a bad joint makes a high resistance, as such defects will cause the trouble you describe. An examination of the armature wires where they are fastened to the segment may show the cause. We would suggest a careful examination of the condition of the soldering or fastening of the armature wires to the segment which shows the trouble.

Editor Electrical Industries: I want to make an induction coil and would like to know what kind of insulation is best to use, can you inform me? Could the close ring coil be used for this purpose. W. W. J., Denver, Colo. 12.

Properly prepared paper is the most satisfactory insulation for such purpose. The paper should be of the kind known as bank note and should be saturated with linseed oil to which a small amount of dryer has been added. An easy way to prepare the paper is to fill a pan of suitable size partly full of the oil and then float the paper on top, changing sides so that both sides of such sheet shall be thoroughly covered with oil. As fast as covered the sheets should be hung on a cord and left until thoroughly dried. The ring style of coil would give fully as good, and perhaps better, results if a special magnet was employed for breaking the circuit. Such coils are more difficult and expensive to wind than the style more commonly employed. The straight coil may be considered best where a battery is used.

Editor Electrical Industries: I have a telephone in the store and live in the rooms above, and after the store is closed, if there is a call at the phone, the bell cannot be heard in our rooms. I would like to make some kind of a connection from the telephone circuit to the rooms above so that I can hear the bell whenever there is a call at the phone. D. H., Janesville. Wis. 13.

There are a number of ways of accomplishing this result. One is by using bell and battery with contacts so arranged as to close the circuit by the movement of the striker of the magneto bell. Your local telephone man will undoubtedly arrange a call for you if called upon.

Editor Electrical Industries: Would it be practicable to rewind the armature of a 50 light dynamo so that there will be but one-half the number of armature sections used? The winding is of No. 8 wire, double cotton covered, and each wire goes twice around the armature, the beginning of one wire joins the end of the preceding one at the commutator segment. There are now 84 sections in the commutator, but we would like to make a change as above noted. We will rewind the armature if it is practicable. The machine is used for incandescent lighting and has had pretty rough usage. Dynamo, Omaha, Neb. 14.

We would not advise such change being made, as by reducing the number of commutator segments other difficulties would be introduced and the machine would in all probability spark badly. One reason for using so great a number of segments in the commutator is to reduce the electro motive force between two adjacent segments so that a spark cannot be produced under correct conditions of operating. If you have had no experience in armature winding you will probably meet with considerable trouble, and be at an extra expense, before the armature can be made to work properly, even if no change is made in the style of winding.

Editor Electrical Industries: What kind of carbon is used for making the contact pieces or electrodes in a telephone; and would it be an infringement to make such a telephone? A. F., Hammond, Ind. 15.

Nearly any kind of carbon such as is used in electrical work, would be suitable for use in a telephone. Such a telephone would until the telephone patents now in dispute are settled infringe existing patents. We should suggest, as the simplest and most easily constructed telephone, the magneto telephone which requires no battery, nor anything in its construction but what is easily procured.

The B. & O. Special to the Convention.

The large number of delegates to the convention from New York and vicinity necessitated the running of a special train. After due consideration of the various routes Mr. C. O. Baker, master of transportation, selected the B. & O. as the best suited to the comfort and convenience of the electrical delegation, and no effort or pains were spared by him to make the trip a pleasant one for all who might go. The train was a handsome one, made up exclusively of Pullman coaches, every seat being taken. A remarkable run of four hours and forty-three minutes was made from New York to Washington, this being the fastest time on record between those points. The railway officials realizing the fact that the electrical people were worthy of special attention endeavored to give every facility for comfort, and the trip was enjoyed by every one, including the ladies, who formed a good portion of the party.

The delegation from Chicago and the west was, it is to be regretted, very small. Many intended to go, and arranged to do so, but at the last minute found it impossible to leave. This no doubt accounts for the fact of the small attendance. The official route selected was over the B. & O. and those who went that way were highly pleased with the trip.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Washington, Ia.—The Washington Illuminating Company will add a commercial arc light circuit. George T. Lewis is purchasing agent.

Little Rock, Ark.—The Arkansas Electric Supply Company has been awarded the contract for installing an electric light plant at Searcy, Ark. They desire quotatations on new and second hand machinery for the same.

Charlotte, N. Y.—The Grand View Peach Railroad Company will install an electric light plant soon.

Williamsville, N. Y.—The Buffalo and Williamsville Electric Railway Company will add two motor cars.

Fostoria, O.—The Isaac Harter Company will soon double its present incandescent light capacity.

Two Rivers, Wis.—The Two Rivers Manufacturing Company may add another dynamo. G. W. Kessman is purchasing agent.

Navasota, Tex.—E. L. Bridge contemplates adding a boiler and dynamo.

Goshen, Ind.—The City of Goshen may add an incandescent plant soon. C. S. Dill is superintendent.

Elkton, Md.—The Elkton Electric Light & Power Company may add arc lights to its equipment. C. R. Maxwell is purchasing agent.

Rock Falls, Ill.—The City of Rock Falls may erect a plant soon. Address D. O. Coe. Mayor.

Yreka, Cal.—The Yreka Electric Light Company has recently increased its equipment and other improvements are contemplated.

San Diego, Cal.—The City of San Diego invites sealed proposals for lighting the streets, avenues and parks of that city with electricity for a term of one year from expiration of present contracts. Proposals to be delivered between ten and eleven o'clock a. m., Thursday, the 22nd of March. The proposal provides for the construction and operation of an electric light system similar to the one now in use in that city. Address, S. W. Belding, Sec'y Board of Public Works.

Lampasas, Tex.—Messrs. J. T. & W. L. Donovan have bought the present lighting plant and propose to run it by water power.

Hillsdale, Mich.—The city has purchased of F. W. Stock his light plant, which has been rebuilt and put in good order. Wiring for new lights is now in progress. E. M. Washburn is chairman of committee

Richmond, Ind.—The Light, Heat & Power Company's plant was recently burned. It will be rebuilt and equipped as soon as possible. J. W. Roney is purchasing agent.

Ada, O.—The village of Ada, Ohio, desires to negotiate with a good electric light company for lighting the streets of Ada for a period of five years on a basis of 35 lamps; to be lighted all night during the nights to be lighted. None but the best methods will be considered. F. L. Rice, clerk.

Crown Point, Ind.—The Crown Point Electric Lighting & Power Company recently sold its plant to Mr. Edwin S. Tice, who is now repairing and placing it in first class condition.

Adrian, Mich—The Electric Light & Power Company (limited) proposes to add incandescent lights soon as business revives. J. H. Fee is superintendent.

Owasso, Mich.—The Owasso Electric Company contemplate extending its lines for residence lighting. R. E. Travis is purchasing agent.

Menominee, Mich.—The Menominee Electric Light, Railway & Power Company will soon install a 1,000-light alternating machine.

Brooklyn, Mich.—L. W. Greene & Brother contemplate adding arc lighting apparatus.

Ovid, Mich—Mr. F. W. Calkins, owner of the Ovid lighting plant may add a new engine and a 25 arc light dynamo in the spring.

Jonesville, Mich.—The Jonesville Electric Light & Power Company contemplate adding 7 arc and 200 incandescent lights.

Marshall, Mich.—The city contemplates adding to its plant a 100-horse power turbine and an alternating machine. P. S. Jay is purchasing agent.

Buchanan, Mich.—The Buchanan Power & Electric Company will install a complete incandescent plant, also a power generator.

The Lynn Manufacturing Co., 620 Atlantic Ave., Boston, Mass., is among the newer companies engaged in the manufacture of supplies and equipment for electric railways, but one which if age were reckoned in the experience of its officials would be one of the oldest. The company has a well equipped factory at Lynn.

FINANCIAL.

As Spring approaches the business outlook brightens and the evidences are before us that the business depression which has so long hung over us is passing away. A more active spirit pervades the electrical trade, and although prices have not advanced the tendency to increase the stock on hand is general, receiving encouragement from the increased sales of machinery and supplies. The greater demand has been felt at the factories whose forces have been increased until it is safe to say that there are at the present time more men employed than at any time during the past eight months. The new apparatus and improvements being brought out are also evidences of the return of better times.

During the past month a number of large orders and contracts of considerable size were made for central station equipments. Small plants of from 100 to 3,000 incandescent lights for isolated lighting are being installed in sufficient number to furnish the manufacturers of engine and boiler as well as electrical equipments with work for some time. In supplies, electrical appliances and specialties, the trade has been a marked improvement over the previous month.

The stock market has shown weakness in some directions, while in a few cases a firm advance is noted. General Electric reached on Feb. 28th, 40¾, the highest point in some time. This, although due in a measure to the Wall Street manipulatons, it is in a measure warranted by the more business-like methods pursued by the officials of the company. The conservative management, if continued, will save an immense amount of expense in office expense alone by the changes which have been made from the main office to the smallest branch. The company is said to have secured facilities and rates from Schenectady which will be very valuable in the transaction of business. The factories at both Schenectady and Lynn are running with a fair prospect of increasing the number of hands.

•NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING Feb. 8.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	169
" " "	Bds. 1893.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co... ...	Com.	14,000,000	100	....	....	85
Commercial Cable Co	Com.	7,716,000	100	....	....	120
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	F. Q.	124
" " " ...	C.Bds. 1898.	71,000	100	6	M. & S.	.....
" " "	C.Bds. 1901.	586,500	100	6	M. & N.	.....
" " Brooklyn..	Com.	2,500,000	100	....	Q. F.	85
" " " ..	1st. 1940.	500,000	100	5	A. & O.	100
" " " ..	Regis.	....	100	5	A. & O.	.....
" " Chicago...	Com.	3,000,000	....	8	Q. F.	.....
" " "		2,500,000	....	....	....	.....
" " New York.	Com.	7,938,000	100	....	Q. F.	97
" " "	1st 1910.	2,562,000	100	5	M. & S.	104½
" " Phila......	Com.	1,473,000	100	....	....	120½
" " "		....	....	5	....	.....
Fort Wayne Elec. Co...... ...	Com.	4,000,000	25	....	....	4½
General Electric Company.	Com.	30,457,000	100	....	....	40¼
" "	Prf'd.	4,251,900	100	....	....	65
" "	Deb. 1922.	10,000,000	100	5	J.-D.	70
Gold & Stock Tel. Co............	Com.	5,000,000	100	....	Q. J.	.... .
Northwestern Gen. Elec. Co.....	Com. •	1,000,000	100	....	....	.....
" " "	Prf'd.	750,000	100	....	J. Q.	.....
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	...	....	.....
Thomson-Houston Elec. Co . .	Series D.	180,000	10	....	....	5⅜
Thom'n-Houst'n Intern.Elec.Co.	Com.	600,000	100			.....
" " " "	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co....	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q J.	81¼
" "	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	26
" " "	1st Pf.Cum.	3,755,700	50	7	....	46
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R..............	Com.	6,000,000	10	....	Q.-J.	170
" "	1st Bds.1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	...	Oct. 1.	.....
" " " ..	1st Bds.1909	300,000	100	5	J. & J.	....
" " " ..	Certf. 1894.	300,000	100	6	J. & J.	....
BUFFALO—						
Buffalo St. Railway.............	Com.	5,370,500	100	5	....	.....
" "	Bds. 1931.	5,000,000	100	....	F. & A.	.....
BOSTON—						
West End St. Railway..........	Com.	9,085,000	50	..	J. & J.	58
" "	Prf'd.	6,400,000	50	5	J. & J.	80
" "	Bds. 1902.	3,000,000	100	....	M. & N.	.....
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	.....
" "	Prf'd.	1,000,000	100	5	A. & O.	.....
" "	1st Bds.1930	6,000,000	100	....	J. & J.	.....
NEWARK, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	...	....	27⅜
" "	Bds. 1930.	6,000,000	100	5	J. & J.	84½
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	155
" "	Bds.	2,000,000	100	....	....	.....
PITTSBURGH—						
Duquesne Traction Co........ ...	Com.	3,000,000	50	...	....	22½
" "	Bds. 1930.	1,500,000	100	5	J. & J.	102
Fed. St. & Pleas. Val. R. R.......	Com.	1,400,000	50	....	J. & J.	17⅜
" " " " "	Bds. 1919.	1,250,000	100	5	J. & J.	100
Pittsb'gh, Aleg. & Man. R. R.....	Com.	3,000,000	50	....		38
" " "	Bds. 1931.	1,500,000	100	5	J. & J.	100
Pittsburgh & Birming. R. R.....	Com.	3,000,000	25	....	......	12
" " "	Bds. 1929.	1,500,000	100	5	M. & N.	98
ROCHESTER—						
Rochester Railway Company....	Com.	5,000,000	100	...	....	67
" " "	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway..............	Com.	2,500,000	100	....	Q.-J.	72½
" "	Bds. 1910.	1,500,000	100	5	J. & J.	100
St. Louis & Suburban............	Com.	2,500,000	400	....	....	30
Union Depot Railway............	Com.	1,200,000	100	....	....	.....
" " "	Bds. 1910.	1,000,000	100	6	A. & O.	100

The Westinghouse stock has received scarcely any attention. The company is, however, preparing for a larger business. The establishment of an office at San Francisco with experienced men at the head, will place them in touch with the trade of the Pacific coast. The force at the works has been slightly increased, and the business promised will place a still larger number on the pay roll. The greatest activity has been noticed in telephone stock. Bell telephone has fallen to 165. It is rumored that the Bell and Postal Telegraph Companies are to be consolidated, but the report has not yet been confirmed. The stock of a number of Eastern telephone companies has been increased for the purpose, it is said, of occupying the field more completely against competitors.

NEW BOOKS.

Dynamo and Motor Building for Amateurs, with working drawings, by Lieut. C. D. Parkhurst, U. S. A., New York; the W. J. Johnston Co. Ltd., 41 Park Row; 163 pages, 71 illustrations. Price, postpaid, $1.00.

Instructions, accompanied by cuts showing the details of the machines, are given for the construction of simple electric dynamos and motors. The machines are simply made, and are within the capabilities of any one with ordinary ability. Directions for the construction of three motors are given, a small bi-polar motor, suitable for a fan, and two sewing machine motors. A dynamo of 50 16-candle power light capacity is also described sufficiently to enable it to be constructed. Information of value to any one contemplating the construction of either motors or generators is given in a general way. Many persons interested in the subject have been deterred from the construction of machines either for their profit or amusement on account of the want of a simple guide of this kind.

The "Practical Engineer" Pocket Book and Diary. By W. H. Fowler, Editor of the Practical Engineer, 1894. Technical Publishing Co., Limited, 6 Victoria Station Approach, Manchester, England. 325 pages. Price one shilling. Roan, gilt edges with pocket and elastic band 1 s. 6 d. Net, post free.

Especially designed for the steam and mechanical engineer, and the power user, it is a compilation together with a diary of a large amount of useful information. The numerous tables which are made clear in the accompanying text even to those who have not had the benefits of a technical training are worth many times the price of the book. The proper construction and operation of a steam plant is treated and the subject of boilers, engines, condensers, economizers, etc., etc., are carefully and separately considered. Under the head of Incrustations in steam boilers, the cause and treatment is considered. Formulæ are given for preventing the incrustations in different kinds of water. Some twenty-five pages of closely condensed matter are given to power transmission. The subject of testing is considered at length including the method of testing the different parts of the power plant. The size of the book (5¼ by 3½) is most convenient for the pocket, while the thin, strong paper used does not make a bulky book of the 325 pages. The flexible leather binding used makes a neat and durable volume.

TRADE PUBLICATIONS.

A very neat calendar blotter for March has been received from The Valentine-Clark Co., of the Rookery, Chicago. The color is rich and blotters good, and the poles, posts and ties, in regard to which correspondence is solicited, must also be of the same quality.

An attractive leaflet has been issued by the Lunkenheimer Company of Cincinnati. Cuts in black and white places for comparison the old style and the Lunken renewable seat gate valves side by side. Price list, dimensions and weights of the valves are given in a very compact form.

The new catalogue of the W. D. Graves Electrical & Machine Co. of Cleveland, O., presents to the trade the line of electrical apparatus manufactured by the company. Half tone engravings show the arc lamp, its adjuncts, switches of a great variety and switchboard appliances, and a view of a 27 circuit switchboard furnished to the Akron General Electric Co. of Akron, O. The cover of imitation leather gives the pamphlet a very neat appearance.

A book for the vest pocket has been published by the Hammond Cleat & Insulator Co., of Boston, Mass. It is styled catalogue A, and not only contains price lists, illustrations and descriptions of the Hammond specialties, but also a number of tables useful to wiremen and blank leaves for memoranda. On the inner cover are tables giving sizes of wire in different systems of measurement. In parallel columns the B & S gauge, C. M., resistance per 1,000 feet, and carrying capacity are given. The wiring formulæ given are very clear and easily used. It is a ready reference book to wiremen and purchasers of electrical specialties. Its convenient size fits the pocket.

The transactions of the American Institute of Electrical Engineers for February contains a very interesting paper by Dr. Louis Bell on "Practical properties of Polyphase Currents." The paper is interesting and contains many experiences in the operation of polyphase apparatus. The system is treated concisely without mathematical formula which make many articles so unreadable to many interested people. In conclusion he says: "I am convinced that polyphase work in one form or another has come to stay. It may not be in the form of two or three phase work just as we know it now; but the principle is pretty sure to stay by us. I do not have many fears that the polyphase plants now installed will be scrapped in a few months by reason of some invention that will entirely supercede them. We have threshed over pretty thoroughly the possibilities of the ordinary alternating current, and by far the most practical thing we have as yet, is the polyphase in one form or another. You 'pays your money and you takes your choice.' In some form it is going to stay by us long enough to make it worth while to develop it a little."

The new illustrated catalogue of the Ohio Brass Company, of Mansfield, Ohio, reminds the electric railway managers that spring will soon be here, and that supplies will be needed in overhauling the line and track, and repairing the work of the frost and the winter traffic. The company make a specialty of construction material, line devices and car appliances, and in this catalogue has placed them before the trade. An extensive line of poles is listed with fittings, tops, brackets, arms, etc. In trolley wire appliances everything used seems to be included. Hangers of every style, pull overs, clamps, splices, ears, switches, insulators, etc.; insulators and fittings for feeder lines are each illustrated in numerous styles. Trolley stands, wheels, harps, etc., rail bonds, and other track supplies are described. For the the equipment of the car an extensive line of appliances are shown, including electric head lights, bracket and cluster lights, sockets, switches, brake handles, track brooms, and many new specialties. For power stations, electrical measuring instruments, gears, pinions, bearings, commentators, and station and track tools are described and illustrated. Although the company has not been brought directly in contact with buyers of street railway supplies, it has had a number of years of experience in the manufacture of these goods, having previously contracted its output to a western supply house. The catalogue shows a large line of goods manufactured of a quality which will compare with any on the market. Of convenient size, neat cover and well-arranged contents this catalogue will undoubtedly be the forerunner of an extensive trade.

The subject of fuel economizers is well presented in a pamphlet recently issued by the American Fuel Economizer & Engineering Co. of 136 Liberty St., New York. The pamphlet is neatly gotten up, the press work is good and the composition excellent. The fine paper and wide margins give the pages an attractive appearance. The fuel economizer is discussed in purpose, construction and operation. The economy in heating and purifying the feed water before it enters the boilers by using the gases after passing from the furnace is pointed out. The advanced ideas employed in the construction of the American economizer, the elimination as far as possible of the faulty and undesirable features in the old styles and the embodiment of new ideas in its construction are points to which attention is called. The descriptions of the economizer and the design of its many parts are greatly elucidated by the drawings which accompany the text. Directions for arrangement, care and operation of the American fuel economizer will be found of interest to not only the users of the economizer but also users of any steam producing apparatus. Useful data for the benefit of engineers and steam users has been collected and is presented in connection with this subject comprehensively arranged. Another interesting feature is the part devoted to power houses in which the American fuel economizer is employed. Among a number of such power houses, a plan and elevation of the boiler house of the Narragansett Electric Light Co., of Providence, having a capacity of 6,000-horse power are shown. A model power plant is suggested in a plan and elevation of a power house in which the most modern appliances are shown, including coal and ash conveyors, mechanical stokers, mechanical draft short stack, gravity feed to stokers, fuel economizer, traveling crane in power house, etc. This plant calls attention to the fact that the company gives considerable attention as designing and consulting engineers to the building of power plants, steam, electrical and hydraulic.

PERSONAL.

Mr. H. I. Hadaway, who has been associated with George Cutter of Chicago, for several years, has now opened an electrical supply house in Louisville, Ky. He proposes to carry a well picked line of both electric light and house goods, and his many friends bespeak for him the success in this new enterprise.

Mr. Geo. E. Pratt who has for a long time been identified with the Lamokin Car Works as its contracting agent has severed his connection with that company to take charge of the street car department of the Jackson & Sharp Company of Wilmington, Del. The high standing of this company with Mr. Pratt's experience will without doubt make this branch of the company's business a complete success.

Mr. H. F. J. Porter, who was first assistant mechanical engineer at the Columbian Exposition during its construction, and afterwards assistant chief of the machinery department, has formed a partnership with Mr. Albert Fisher, who has represented a number of prominent eastern engine manufacturers at Chicago. With their extended list of acquaintances and previous experience success will undoubtedly attend them.

BUSINESS NOTES.

Mr. George Cutter, 851 The Rookery, Chicago, says his street hoods are "going like hot cakes." The reason is plain—a thing well advertised is bound to go.

Mr. Charles Wirt, Chicago, is now in possession of a laboratory at 56 Fifth Ave., where he has moved the Wirt laboratory, with the stock of Wirt indicators, purchased of the Ansonia Electric Co.

W. L. Lee & Co., 273 So. Canal St., Chicago, are closing out a large stock of new and second hand machinery of almost every kind. Second hand engines, boilers and accessories are listed at very low prices.

The Hawks Electric Company, of Boston, Mass., is having numerous calls for the well known Hawks' street fixtures. The many points of merit possessed by this fixture can alone account for the unprecedented success it has had.

The Eddy Electric M'f'g Company, Windsor, Conn., report business as greatly improved, and a number of sales of the new generators. The company is in shape to handle a large business in the special lines in which it has previously been so successful.

Cushing & Morse, Chicago, general western agents for "Kerite" wires and cables, report that judging from the large number of nice orders that are coming in at the present time the outlook for business during the spring and summer is most excellent.

The Perkins Electric Switch Company of Hartford, Conn., will shortly place on the market something new in the way of switches. The established reputation of the company in the manufacture of switches would indicate that the new line will be fully up with the times.

The Brown Electric Company, Boston, Mass., has secured the exclusive New England agency for the switches and sockets manufactured by the Iona M'f'g Company, of Boston. The company is also making great progress in the street railway field for which it handles an extensive line of goods.

The Belknap Motor Co., Portland, Me., has opened an office in New York, and expects soon to have an office in Boston. The works of the company are to be enlarged, and a more extensive line of electrical machines and apparatus manufactured. Large generators and alternating current machines are to be built.

The Waddell-Entz Company, 203 Broadway, New York, is now in the hands of the receiver, Mr. Montgomery Waddell. The company possessed many valuable patents, an extensive manufacturing plant; well known business men back of it. The financial embarassment is attributed to the dull business of last year.

The Miamisburg Electric Co., Miamisburg, Ohio, is pushing its battery trade in all directions, the recent improved forms of batteries are being well received by the trade, and the large variety offers a fine and large selection. The company is at work on a number of new specialties which will soon be ready for the market.

William B. Merrill & Company, Boston, Mass., is at present busy filling orders for Tripp metallic packing, which it manufactures and which is now used in the largest steam plants in the world. The number of duplicate orders for this packing has been larger than in any other line and shows its general adoption after once being used.

Hood & Osborn, Chicago, western managers of the LaRoche Electrical Works, recently sold a 13-light alternating machine to the Hammond Electric Light & Power Company of Hammond, Ind. The order was obtained in the face of very strong competition, and consequently Messrs. Hood & Osborne feel much elated at their success in securing the order. Business in general they report as improving.

Mr. J. H. Cooke, representing the "Buckeye" lamp in Chicago and adjoining territory, says: "All we ask for the 'Buckeye' is a 'fair field and no favor.' Now that it is understood that the lamp is lawfully made, that our customers have nothing to fear from suits for infringement or threats of same, that our factory is and will continue to run wide open, we are feeling the effect in a satisfactory and increasing demand for lamps."

The Mosher Electric Company, Chicago, has just secured the contract for 60 of its new alternating arc lamps for the municipal lighting plant of Sandwich, Ill. This is an entirely new type of lamp, and was fully illustrated in the last issue of Electrical Industries. The company deserves great credit for having secured this order, from the fact there was great competition with other manufacturers. Many superior points of merit are claimed for this lamp.

The F. E. Belden Mica Mining Co., of Boston, Mass., has recently completed a new mill to run in connection with their present plant at Rumney, N. H. The new addition covers 40x80 feet and is two stories high. Attached to it is a brick boiler and engine house, 22x36. The new factory will be dedicated Friday evening, March 2nd. The invitations for the affair are very unique, being clear mica, gold lettered and tied in one corner with red, white and blue ribbon.

Fisher & Porter, 1025 Monadnock Blk., Chicago, is the name of a new firm doing business as manufacturers' agent and contracting engineers. The firm is the western representative of the Providence Steam Engine Co., builder of the Improved Green eng., and of the Altoona Mfg. Co., builder of the M. A. Green engine. Both slow and high speed engines of this grade will be handled. It is expected the present negotiations will soon be closed and that other eastern manufacturers will be represented by this firm.

Mr. J. E. Way, manager of the Chicago office of the R. Thomas Sons Company, at 115 Dearborn St., reports the trade in the hard vitreous porcelain electrical supplies as very encouraging. The company has recently made large additions to its plant which adapts the works especially for the manufacture of porcelain electric telegraph, telephone and electric light supplies. No metallic oxides are used in the glazing as in ordinary china and earthenware. The process of manufacture makes it a thorough insulator.

The National Statistical Association, Washington Loan & Trust Bldg., Washington D. C., is the name of a company recently incorporated under the laws of Congress for the District of Columbia. It will establish and maintain a bureau of legislative, legal and statistical information. The officers of the company are known to many of our readers. The president is Mr. William B. Webb; vice-president and manager Allen R. Foote; treasurer, Henry Randall Webb and secretary and statistician, George S. Boudinot.

The Interior Conduit & Insulation Co., New York, has placed on the market this year an iron armored conduit, a much more substantial and durable conduit than either the plain or brass armored conduit. The interior insulation is made continuous at the joints by the use of a thin sleeve inside the tube. Standard gas fitters tools for cutting and threading the conduit are used in its installation. The first building in Chicago for which iron armored conduit is specified is the new public library building on Michigan Ave.

Taylor, Dee & Mack, Chicago, have been quite busy of late and report an increase of orders from central station companies for miscellaneous material. This firm have a large stock of miscellaneous material on hand, obtained from the World's Fair, which they are offering at attractive prices. They also have at present a large assortment of second-hand transformers of almost all the different styles which they are selling at very low prices. Wirt's dynamo brushes and central station indicators are two leading specialties of the firm.

The Mather Electric Company, Manchester, Conn., has recently been re-organized and if we are to judge by the men back of it the company is in good financial condition. The new officers of the company are president, Mr. Maro S. Chapman; vice-president, T. C. Perkins, and secretary and treasurer, John L. Bunce. The directors of the company are Charles E. Perkins, J. C. Perkins, M. S. Chapman, John S. Bunce, Charles M. Jarvis, Henry C. Redfield and Norman McD. Crawford. These gentlemen are all well known in business circles and the trade may expect to see considerable activity in Mather apparatus.

The Day-Moberg Electric Co., 54 Pearl St., Boston, Mass., reports that the Jupiter storage battery recently placed on the market, is meeting with a great success. The method of construction is such as to prohibit the buckling of the plates and other evidences of weaknesses which appear in many batteries after a short time in use. Economy and efficiency is claimed for the cell greater in proportion to its weight than any other. No short circuits are possible and no loss of current can take place from this cause. The company is also making a small motor which, although small, is strong and efficient.

The Metropolitan Electric Company, 186 Fifth Ave., Chicago, expects to have its new 400-page catalogue ready for distribution by March 10. The address of any one desiring a copy will be filed when received and a catalogue sent as soon as reached by the mailing department. The trade of the past month has been very encouraging, especially in railway construction material. The products of the Standard Paint Company, for whom the company is general western agent, have been in great demand, especially the P. & B. tape, which is finding many friends in the railway field. In general supplies the trade is constantly expanding.

Electric Appliance Company, 242 Madison St., Chicago, has built up a very good trade in fixtures, and fixture accessories. A contract of a considerable importance has just been completed at the Chicago postoffice building. The offices in the addition recently constructed have been equipped with the latest devices of this kind, every desk and cabinet has been fitted with specially constructed fixtures. The contract being of considerable size, the competition was close, but the Appliance company was the winner. The company has quietly built up a trade also in Acme tape, which now accompanies nearly every order for wire. O. K. weatherproof and Paranite wire are advancing in popularity, as each month shows larger sales.

The Westinghouse Electric & Mfg. Company, Pitttsburgh, Pa., establishes the first of this month an office at San Francisco, California. The importance of this field has necessitated this step. The company has maintained the excellent quality of its electric railway, lighting and mining machinery which is used to a large extent on the Pacific slope. In the selection of representatives for this district the company has wisely chosen men acquainted with the trade on the coast and well-known in electrical business circles. Mr. H. A. Russell, assisted by Mr. R. B. Elder will look after the interests of the company from this office. The offices are located in the Mills Building and a stock of standard apparatus will be kept on hand to supply immediate wants.

The Great Western Manufacturing Company, 195 S. Canal St., Chicago, reports a large increase in trade during the past month, and also a phenomenal success in the sale of the Howard lamp since reducing the price. The company has received during the past three weeks large quantities of Clark rubber covered wire and cable to keep pace with the increasing demand for it. There has just come from the press some very neat circulars with net prices on all candle power of the Howard lamp, also revised net quotation sheets on the H. G. triple braid weatherproof and magnet wire. The company has also just issued a new sheet setting forth the merits and guarantees of Clark's wires and cables. These sheets and circulars will place the trade in possession of the latest quotations and information regarding these standard commodities.

The Central Electric Company, 116 Franklin St., Chicago, has placed its house goods and retail department in charge of Mr. W. R. Princkard, who is thoroughly posted on these lines, having had a number of years of experience, and being personally acquainted with the trade. The company carry a full line of goods, and among the important specialties in this department are the Edison Leland batteries, physicians supplies, battery fan motor outfits, etc., manufactured by the Edison Manufacturing Company, with which the Central company has special selling arrangements. The metal sheathed bushing, brought out by the Interior Conduit & Insulation Company, has received a large demand since it conforms with the rules of the underwriters and seems to be the most simple and easily used bushing of this kind. The sale of this article, with that of interior conduit, has been a large item in the business of last month. Manson and Okonite tapes which have been long on the market, and the popularity which came to them when first placed on the market, has continued. The calendar sent out by the company has taken with the trade, and many complimentary letters have been received regarding it.

The Ball Engine Co., Erie, Pa., notwithstanding the dull times, has done considerable shipping of engines lately. Among the very recent shipments made by them are the following: One 300-horse power, single cylinder engine, to Risdon Iron Works, San Francisco, Cal.; one 250 horse power tandem compound, to San Diego Street Railway Co., San Diego, Cal.; one 350-horse power cross compound, to Utica Belt Line Ry. Co., Utica, N. Y.; one 100-horse power single cylinder direct connected engine to Willoughby, Hill & Co., Chicago.; three 100-horse power tandem compound engines, to the State Asylum for Chronic Insane, Wernersville, Pa.; one 135-horse power single cylinder engine, to Willard Hospital, Willard, N. Y.; one 300-horse power cross compound engine, to Edison Electric Light & Power Co., Erie, Pa.; one 300-horse power vertical compound engine (in progress of construction) to same parties; one 25-horse power engine, Denison University, Granville, Ohio; one 100-horse power single cylinder engine, House of Correction, Chicago; one 80-horse power single cylinder engine, Watseka Electric Co., Watseka, Ill.; one 500-horse power cross compound engine, Maryland Electric Co., Baltimore, Md.

ELECTRICAL INDUSTRIES.

Vol. V. CHICAGO. April, 1894. NEW YORK. No. 4.

Electric Power Plant for the New Haven Street Railway Company.

The present knowledge of street railway construction and operation enables the railway engineer to plan a street railway as complete in every particular as modern practice allows. He can foretell to a very exact degree the operation of every part of the system, can place before the capitalist a statement of cost of construction and operation that will enable him with his estimate of future patronage to form a very clear estimate of his investment. In the construction of systems operated by electricity the period of experiment is past and the equipment is constructed in accordance with well established rules and data. Recently equipped roads, however, show a great improvement over roads several years in service, both in the method of generating steam and in its transformation into electric power. Improved boilers, compound engines, more compactly and efficiently constructed generators, lighter and more durable motors and improved systems of transmitting the current, together with the skill with which the system is now operated, have placed the modern electric railway in marked contrast with the earlier roads.

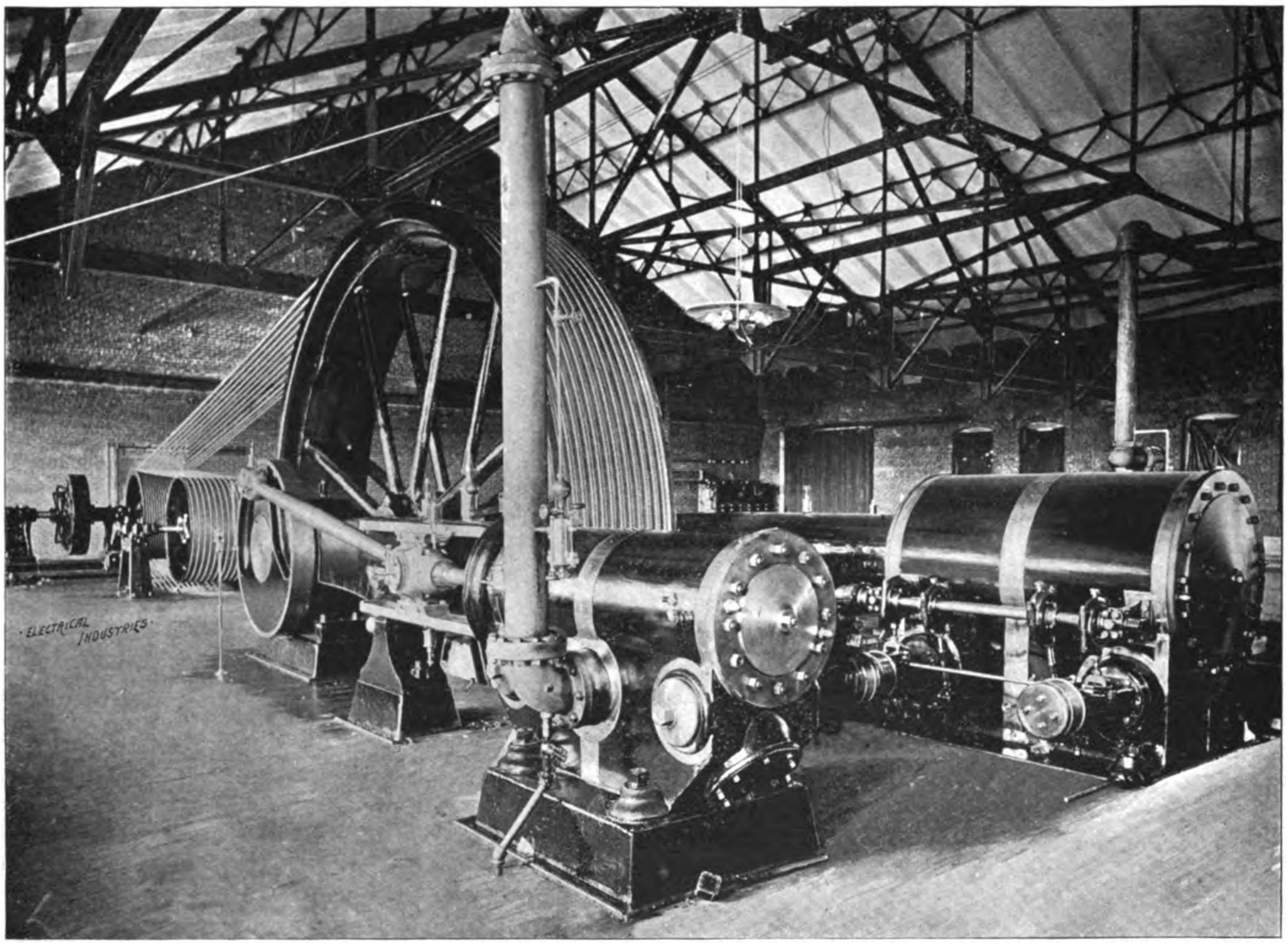


FIG. 1.—ELECTRIC POWER PLANT FOR NEW HAVEN STREET RAILWAY CO.

A road recently equipped electrically at New Haven, Conn., combines in its power house the recently accepted practice in the generation of electricity for power and is worthy of more than passing attention. Several horse car lines together with several miles of newly constructed lines in the city, have been consolidated, and the company incorporated under the name of the New Haven Street Railway Company. The tracks of the old lines were relaid and the new lines constructed with improved bonds, etc. The overhead construction has been done with a special view to durability and permanency, but as far as possible the trolley wire and guys have been so placed as to encumber the streets as little as possible.

The power house is the most interesting part of the system to the mechanical engineer. The nature of the land on which the power house stands required a special form of foundation. For the foundation of the building and machines nearly 4,000 piles were driven on which were placed heavy timber covered with three-inch planking. This part of the foundation is so low that it is covered by the tide Concrete foundations for the building and bases for the engines and generators were built up above this. The building has a number of admirable features which facilitate work about the power house. Besides the engine and boiler rooms and office there is an extensive repair shop, storage for 20 cars, etc.

The boiler room is designed for four batteries of boilers with a capacity of 500 horse power each. The boilers installed are of the Scotch compound, tubular type. They belong to the progressive heating class, each boiler containing really three boilers through which the water passes while being made into steam. One complete boiler comprises: One 60 inches by 16 foot shell with 96 three-inch tubes 16 feet long; above this is another 60 inch by 11 feet, having 114 three-inch tubes, 11 feet long,and a steam super heater which is 60 inches by five feet, containing 112 three-inch tubes five feet long. The heat traverses the under surface of the larger shell, thence through the 16-foot tubes to the upper water compartment. It passes through the tubes of this compartment and thence through the five-foot tubes to the stack. The special claims for these boilers are the economy of fuel, dry steam and safety. A more complete description with detailed drawings of the Scotch boilers will be found in No. 5, Volume IV, of ELECTRICAL INDUSTRIES.

A surface condenser is employed with duplex air and circulating pumps. The trouble which has arisen with many boilers in this section by getting oil into the boilers from the condensed steam, will be done away with in this plant by the use of Sinclair Stuart's patent grease extractor and separator. It is placed in the pipe leading from the low pressure cylinder and extracts whatever oil may have been gathered by the steam.

The engine room will accommodate two 650-horse power cross compound engines and one 1,000-horse power cross compound engines and three pairs of generators. The present installation is two 650-horse power units and two pairs of M. P. 200 General Electric generators.

The engines are of the improved Greene type with E. K. Hill's valve gear and assumes somewhat the form of the well-known Wheelock type. These engines have been installed after carefully considering the heavy and continuous service they will be called upon to perform. It is said that they are competent to regulate within one revolution when operating from zero load to the maximum power of the engine. Each engine has a high pressure cylinder 16 inches and low pressure 36 inches diameter and 48 inch stroke. They are intended to run 110 revolutions per minute and while so doing, with 130 pounds steam pressure, will develop 650-horse power. It is understood in this compound system that the load can vary 60 per cent without any great variation in economy. With the improved valve gear with which these engines are fitted they are able to take steam the full length of stroke, less the lap of the valve, which allows a minimum diameter of cylinder, thereby keeping the engine at its best economy.

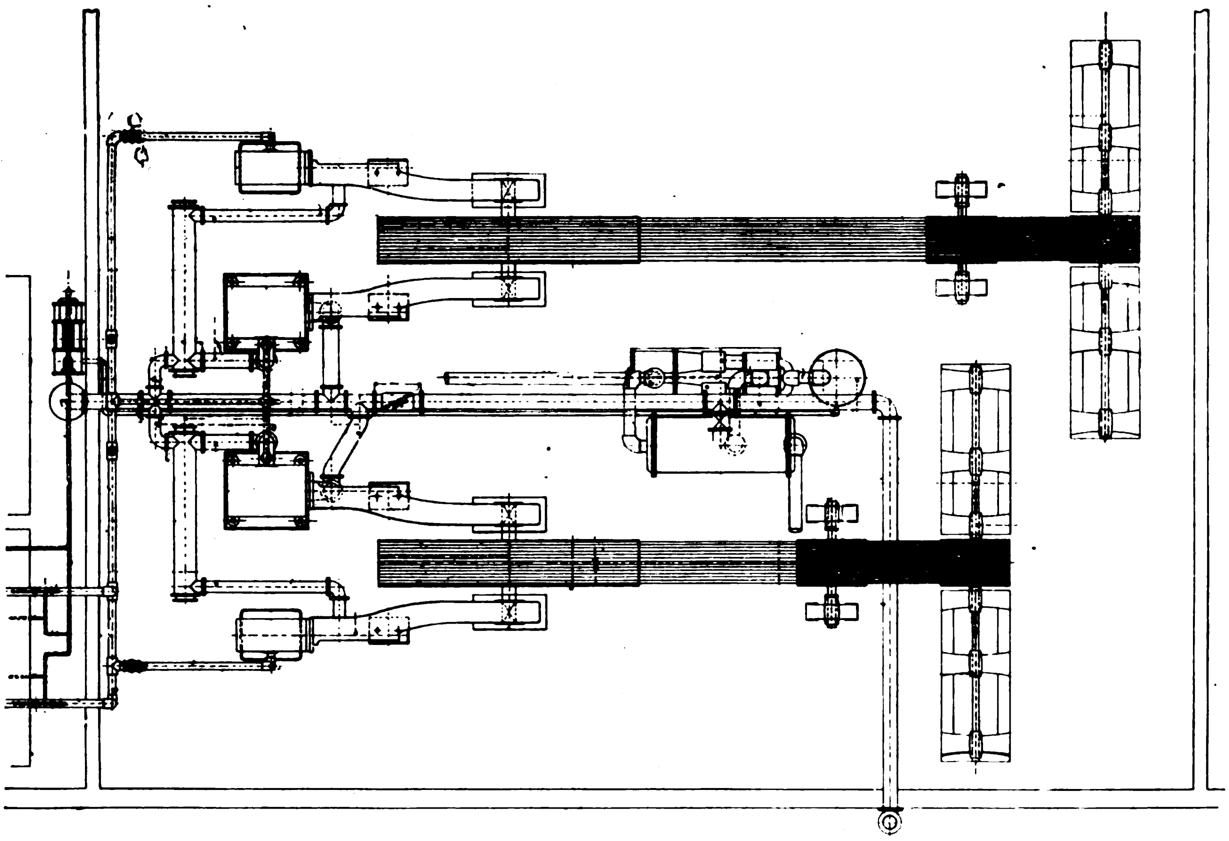


FIG. 2.—ELECTRIC POWER PLANT FOR NEW HAVEN STREET RAILWAY.—PLAN OF ENGINE ROOM.

The fly wheel, as shown in illustration, Fig. 1, is built in halves, with two sets of arms, an iron sectional ring bolted together and lagged with well seasoned maple. It is 19 feet in diameter and grooved for 12 one and one eighth inch ropes, Hoadley's compound wind rope transmission being employed. This system has been used successfully in a number of large power houses recently installed, among which is the power house of the Chicago City Railway, where the rope transmission was severely tested during the World's Fair. Its use in this territory is an innovation and is explained by the fact that a number of western gentlemen are interested as stockholders in this road. The Smith friction clutch is used and a system of electrical let-offs and tell-tales introduced which will enable the engineer or attendant to throw out any of the clutches desired from several points of the building by touching an electric button. The inlet of steam is controlled in a similar manner.

An equal amount of attention has been given to the rolling stock. The cars are neatly finished, light and comfortable. Each truck is equipped with two 25-horse power G. E. 800 motors and the necessary connecting and controlling devices. The silent and easy running of the cars has attracted considerable attention and much favorable comment. The plant was contracted for and furnished by the California Engineering Co., and personally supervised by Hoadley Bros., engineers.

Exterior Decorative Lighting at the Midwinter Fair.

BY GEO. P. LOW.

I have noted that in one or two instances, ELECTRICAL INDUSTRIES in referring to the exterior decorative lighting on the main buildings of the California Midwinter International Exposition, has alluded to it as a series system. Permit me to correct this statement.

In securing the use of dynamos, etc., for the Midwinter Fair, it was found to be impossible to negotiate the loan of an incandescent lighting machine for this particular work as manufacturers refused to send machines to the coast which would, in all probability, find no immediate sale at the close of the exposition. They were quite willing, however, to furnish railway generators, which the General Electric Company did - supplying an M. P. 90 multipolar 550-volt machine. The problem which then presented itself was that of wiring the building so that the least fire hazard would be presented and that, as is the case in ordinary series distribution across a 500-volt circuit, if a lamp burns out it would not be a case of one out, all out. The matter was referred to the writer who was then a member of the electrical engineering staff of the exposition and he, in conjunction with Mr. J. A. Lighthipe, district engineer for the General Electric Co. determined to wire the building on a series multiple system, each multiple to consist of ten lamps and five such multiples in series.

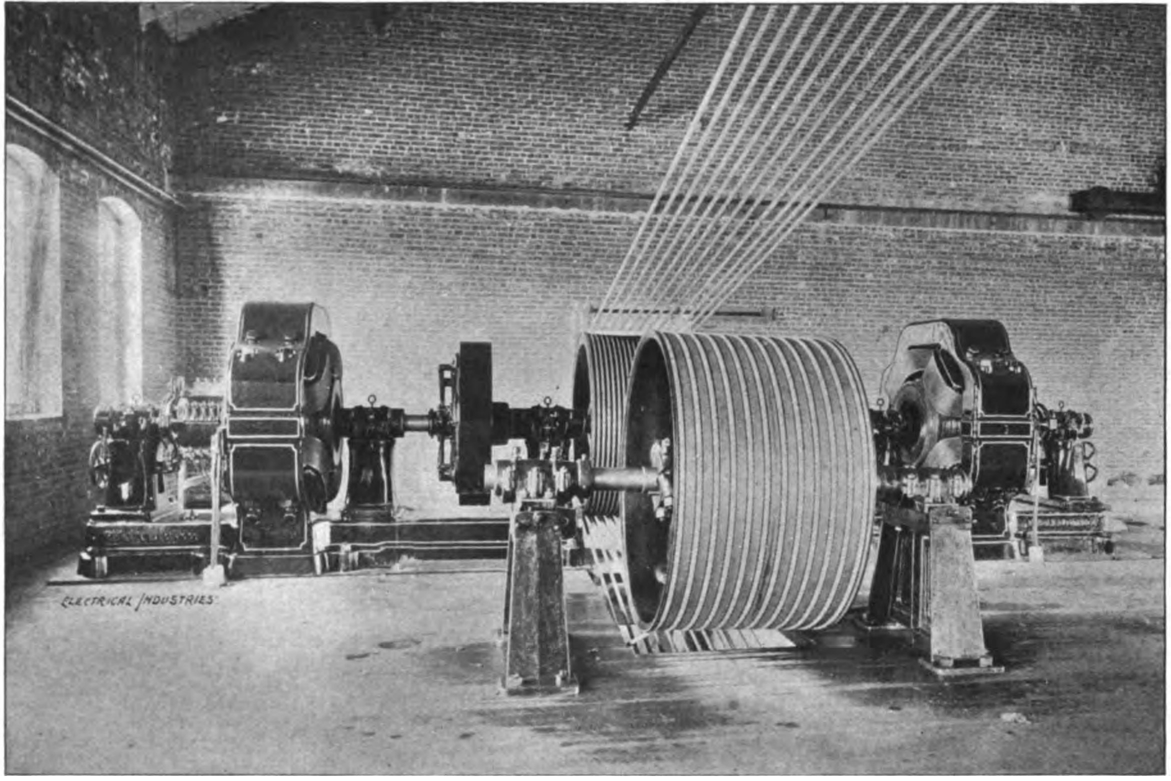


FIG. 3.—ELECTRIC POWER PLANT FOR NEW HAVEN STREET RAILWAY.

It is evident that in this arrangement, if a single lamp in any multiple burns out the other lamps that are in that multiple will burn at a slightly increased voltage while all remaining lamps in the series multiple will be practically unaffected, and the burnt out lamp may be replaced before any material strain is thrown upon the remaining lamps in its multiple. The receptacles used were the ordinary black porcelite receptacle with screw connections which were placed uniformly 24 inches apart, except on the higher lines where the distance was reduced to 20 inches. These receptacles were held away from the wood work a distance of an inch and a quarter by means of 2½ inch screws carried down from the receptacle through a porcelain knob.

It was fully realized by the writer that the question of waterproofing would be the most serious one to contend with and it was his advice that the plaster of Paris bases of the Edison lamps to be used should be thoroughly filled by being boiled in melted paraffine wax. This advice, however, was not adhered to. The lamps were screwed into the receptacles and puttied over, not only around the screw base of the lamp but also within the receptacle (with the idea of preventing moisture from seeping in through the screw in the center of the base) and about the screw connections. The lamps were placed ten days or two weeks before current was first thrown on to the wiring, during which time severe rain storms occurred. The putty proved of no protection, and as should have been clearly foreseen, when current was first thrown on to the circuits the lamps were indeed a sight to behold.

Less than 300 volts was the first potential carried and the illumination presented in the lamps varied from zero candle power to 150 candle power. Perhaps one fourth of the lamps were out and on removing a lamp from its socket, it was frequently found that the socket was filled half full of boiling water. As is usual, it had been announced that the illumination of the buildings would take place on a given date, which was the third day following the experience just recited. It then at once became a matter of taking out all lamps, scraping out the putty and putting in new lamps —which was done, and the public illumination occurred on the date and with a success which has been published. It then became necessary to reconstruct the circuits on each of the five main buildings around the Grand Court and in this reconstruction the advice originally given by the writer has been followed out. The lamps have now been paraffined, rubber bushings have been placed and although three or four severe rain storms have occurred since this was done, the operation of the circuits has been satisfactory.

What I Don't Know About Electricity—Second Paper.

BY GEORGE CUTTER.

I believe in electric lighting and cooking in isolated country homes by private plants and expect quite an increase in this line of work in this country in the near future. "I don't know" the best kind of a plant to recommend for this kind of work. So much has been done in this line in England that we could surely learn some good lessons by a careful study of domestic plants over there. I had the pleasure of assisting in the installation of one domestic plant in England but it was not of a nature to afford much information for our work in this country. The plant cost $10,000 and was not planned for economy in working. A special house was built for the purpose and in this were installed steam boiler, engine, dynamo, storage batteries and an array of testing instruments that would be frowned upon quite forcibly by an American electrician, as these private plants must be planned for practical work without expert attention and not as testing laboratories.

I have built a dynamo house by my suburban home and am puzzled what to install in it. When built it was my intention to install a boiler and engine well equipped with automatic stoker, regulators, etc., which would keep everything in proper working shape for runs of 10 hours or even more. These automatic devices are all easily applied and would tend to develop domestic plants to such a degree of perfection as to lead to their adoption by many householders. I intended to pipe the steam to a system of indirect radiation for heating the house and believe the cost of operating my plant, using exhaust steam for heating my house, would really be very little in excess of the cost of heating the house direct. Probably the best line of work for these domestic plants will be in this direction—studying simplicity and economy and making a special feature of automatically performing all the operations, so that a very little inspection and attention will be required. Of course the ideal plant involves the use of storage batteries, thus tending to make the first cost rather excessive. It is not absolutely necessary to use storage batteries and I am not sure but the perfection of the automatic devices mentioned will render the expense of storage batteries very questionable, especially if cooking and other domestic work is done by electricity. The plant can then be operated all day and evening, the engine being merely placed in the path of the steam from the boiler to the heating system of the house.

Bearing in mind that this steam engine is almost a toy in such a case, two or three horse power generally being sufficient and ten horse power very large, such plants should be developed complete by the parties who intend to push their sale, and furnished like complete bell outfits "ready to put up." The buyer can not buy dynamo in one place and engine in another, etc., etc. Imagine the perplexities of a man who makes it known that he intends to install a lighting plant in his house. The number of "best" and "only correct" devices for each separate part of the plant that would be presented would overwhelm a giant intellect and probably cause the party to feel he had found a great den of thieves from none of whom he could learn the truth.

A gas engine is also a fine method of operating private plants for those residences that have gas in them. Even those that have private gas plants can send the gas through a gas engine to make electric lights and get a certain amount of light for less expense in coal than by burning the gas direct for light. Gasoline and kerosene engines are probably the cheapest of all for small powers and are easily installed and operated. My reason for hesitating about installing the steam engine outfit in my house is not because of a doubt of its being the best but because of a little sentiment, viz., a desire to play with the problem on lines that might develop more practical and simple means of domestic lighting and cooking. Some fine day in the near future we are going to learn how to produce electricity direct from crude materials at much better efficiency than through the boiler and engine. Possibly a primary battery that will yield valuable by-products may come before the cheap electric generator above hinted upon but these batteries are not likely to help much in isolated residence lighting, as the owners will not care to become by-product dealers. The makers of such batteries could of course buy all the valuable by-product. Primary batteries without valuable by-products can be made so as to be useful for residence lighting and at a cost that will not be prohibitive. And my present hobby lies in this direction. It is a promising field to work in.

Large thermopiles (furnace generators of electricity) afford an equal interesting field of work but probably less promising than primary batteries. Available water power is not open to discussion as the lucky owner of a water power large enough to do his lighting and cooking by electricity is unqestionably in possesion of the means of procuring the greatest of house comforts, natural gas not excepted. A great field for this work is open to the enterprising engineers in the irrigation regions of the west. Windmills come in for the last method to be suggested in this paper and to be passed over lightly as they are simply not in the race at all. If a moderate breeze would develop enough power without a giant wind-mill or if strong breezes would blow with such regularity as to afford a fair daily average, this method would be the prize winner. But as a gentle breeze does require an enormous wheel for the power and as stiff breezes are very irregular and often much too strong thus using up the total mileage per month in a few storms, the windmill is simply not in the race.

Fire Alarm System in Stock Barns.

The various electrical devices now so generally used can no longer be classed as luxuries but as necessities. Their use is extending to the country as well as in the cities and towns. In a stock barn recently erected on the stock farm of Mr. L. P. Morton at Ellerslie, near Rhinebeck, N. Y., a very complete fire alarm system has been installed together with electric lights, etc. The barn is 297 feet long by 65 feet wide with an L 89 by 52 feet. A thermostat is placed over every 100 square feet of space and throughout the lofts so that it is impossible for the temperature to rise above 140 degrees in any part of the barn without giving the alarm at the office. For the equipment of the barn 300 thermostats were required. There are 30 incandescent lights in the barn which are sufficiently well distributed so that oil burning lanterns which have been so disastrous to many barns, are not required. The power house is situated some distance from the barn and steam for the engine in the barn is transmitted through an underground pipe.

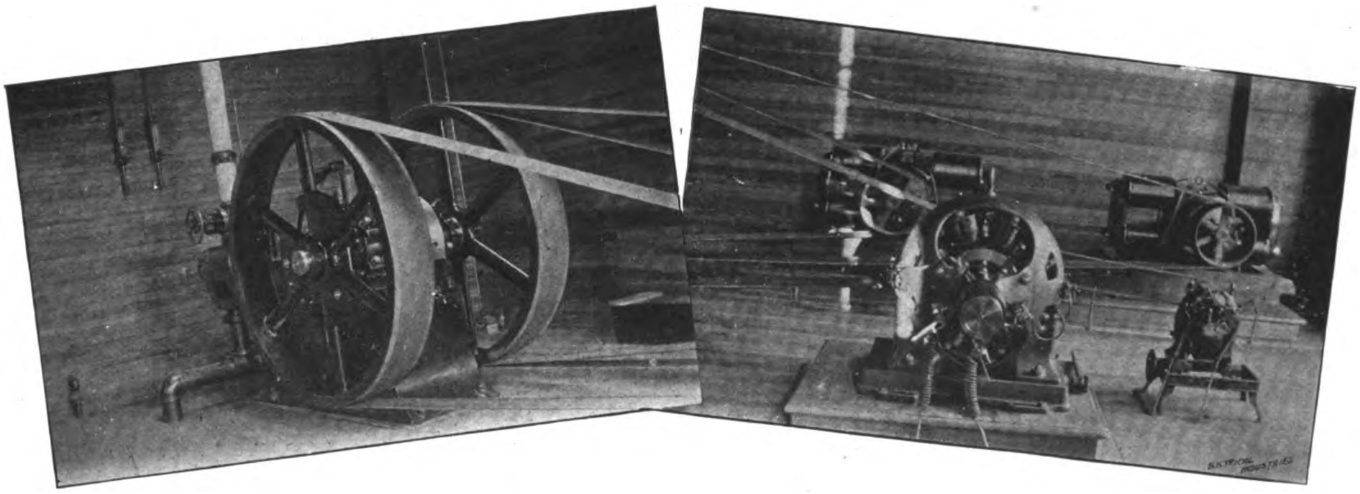
Electric Lighting at Rochester, Minn.

Something over a year ago the subject of lighting the streets of Rochester, Minn., with electric lights came under discussion. After a considerable time spent in considering the various phases of the subject it was finally decided to erect a municipal plant and operate the system under the direction of the city. Many of the neighboring cities in the northwest, being interested in the subject, have watched the actions of Rochester and the construction of its lighting system. Delegations from Mankato, Waseca, Owatonna, Chatfield, Winona and Fargo have visited Rochester for the purpose of inspecting the station and systems of lighting. The methods pursued in the installation of the plant have been commended and the electric lighting plant and station is pronounced one of the best installations in the state. Having settled the question of municipal lighting the city retained Mr. F. H. Pickles, city engineer of Winona, as consulting engineer. Under his supervision the general plans for the lighting of the city were determined upon.

It was necessary to construct a building which would accomodate future needs as well as those of the present and the present building and arrangement of machinery were planned by Mr. Pickles with that in view. The city contracted with the Western Electric Company for the entire plant except the ground on which the station stands. The contract was made in accordance with modern business methods, bonds were required for the proper completion of the work and the perfect operation of the machinery for a sufficient length of time to determine its perfect construction.

The construction of the station and lines of distribution and the installation of the station machinery occupied some four months. Everything being in readiness the lights were started for the first time on March 8th. The system has since been operated a sufficient length of time to convince the city council and its engineers of the thorough character of the installation, and it is now in the possession of the city. The station is a substantial structure, built of brick and located in a convenient part of the city. For handling the machinery and the delivery of fuel the building is admirably arranged. High ceilings will give it good ventilation and make it cooler in the summer. The boiler room contains two 16 by 16 foot boilers with furnaces equipped with Gordon patent hollow grates in connection with which a No. 4 Sturtevant blower operated by a four and a half horse power upright engine is used. A Raze feed water heater of sufficient size to accommodate the boilers and a Deane six by four by six duplex steam pump also form important parts of this equipment. The two boilers are set in one battery and are so connected that either or both boilers may be used at the same time. In addition to the water gauges on the boilers there is also one in the dynamo room so that boilers may be watched from that point Every thing in the boiler room has been installed in accordance with modern practice and made as near perfect as possible.

On a substantially constructed foundation is a 15 by 14 Ideal engine from the works of A. L. Ide & Son, Springfield, Ill. So well has the engine been set and operated that a dime placed on its edge on top of the cylinder remained in that position for three quarters of an hour, the engine driving at the time a load of 120 horse power. This engine drives two 40 light 2,000 candle power (450 Watts) Western Electric Company's high tension arc dynamos, one 500 light (16 candle power) Westinghouse incandescent dynamo and one type F exciter. The arc dynamos are of the latest type of the Western Electric machines and are provided with reducing switches for operating the lights at different degrees of brightness between 1,200 and 2,000 candle power and other devices of recent design. The regulators are of the company's standard type which have been so successfully used in connection with these machines. The incandescent dynamo is composite wound and generates current at   volts which is transformed into 50 volt currents for lighting.



FIGS. 1 & 2.—ELECTRIC LIGHTING AT ROCHESTER, MINN.

The controlling and regulating devices are mounted on a handsome marble switch board. The instruments are nearly all of Western Electric manufacture and are mounted on white marble bases to correspond with the board. Besides the ammeters, volt meters, switches and rheostats there are 12 spring jacks with plugs for the arc circuit; two polarity indicators, a combination ground detector, a switch board transformer, etc. The ground detector is arranged to indicate a ground from either side of any one of the circuits by simply revolving the movable bar and pressing on the respective buttons which correspond to the sides of the circuit. The rheostat for varying the strength of the fields of the alternator is of the Western Electric Co's new type and possesses the advantage of enabling the operator to vary the candle power of the lamps without it being perceptible owing to the gradual manner in which the resistance is interposed in the field circuit of the alternator.

The outside construction of the plant has been very neatly done; the pole lines were surveyed so as to get the poles in a perfect line. The wires have been drawn taut and the entire system placed in the best condition. Wherever the direction of the line changes the pole on which the line turns is guyed to a post set for that purpose. Stranded wire has been used for the guy wires, as being less liable to break than solid wire. The main line poles are 35 feet long and the lamp poles 40 feet. For the construction of the street circuits 293 35-foot poles, 150 40-foot poles and 71,400 feet of arc wire were used.

For street lighting there are 66 lamps now in use and on the commercial circuit in which there were 3,400 feet of No. 6 wire, there are seven arc lamps in use. On the incandescent circuits there are 517 16-candle power lamps wired for and in use. For these lights two 5-light, four 20 light, five 30-light, two 40-light and four 60-light transformers were necesssary. The transformers are placed upon poles at a sufficient height to be out of reach of inquisitive persons. For inside wiring fire proof wire has been used exclusively.

The arc lamps are suspended in a manner which is generally considered the most efficient. From the tops of the 40-foot poles, placed on the opposite corners of street intersections, a cable is stretched, from the center of which an arc lamp is suspended. The light is thus distributed equally in the four directions. Inducements in the shape of very low rates have been made the citizens to place electric lights in their stores and residences. Orders have been received for a much larger number of lights than the present capacity of the station. The present rates that are made for one year, are arc-lights, $5.00 per month; incandescent lights, one-half cent per 16-candle power lamp hour. Of the capacity of the incandescent dynamo (500 lights) 517-16 candle power lights are wired for, of which number 50 are used by the city. Whether the capacity of the station will be increased at present or not, has not been determined upon. The efficiency and cost of operating the present plant will undoubtedly determine this question. The station has so far performed its work in a manner above criticism.

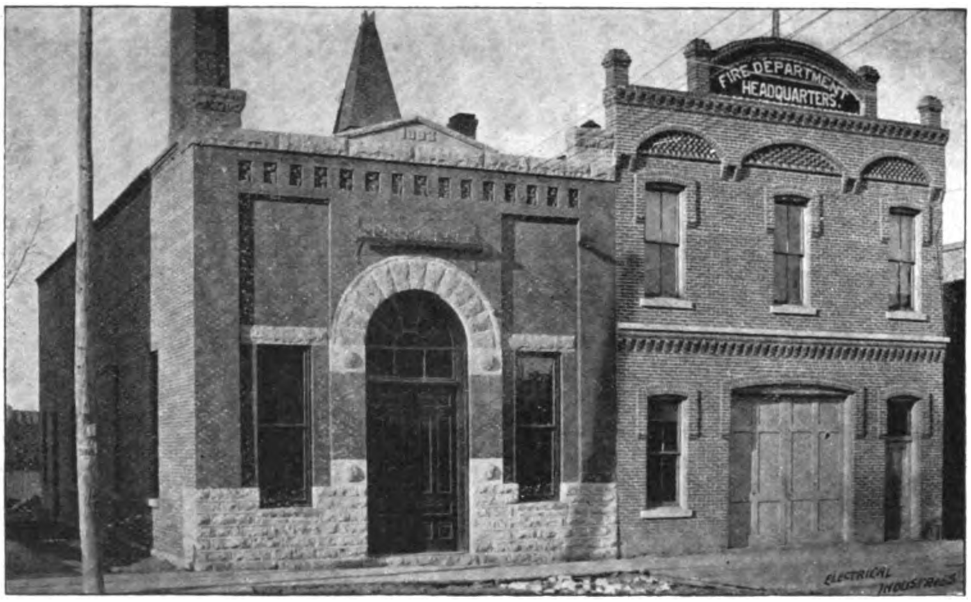


FIG. 3.—ELECTRIC LIGHTING AT ROCHESTER, MINN.

The street circuits are operated on a moonlight schedule until 12 o'clock. No estimate has as yet been made of the cost of the station per year, but during a run of seven hours, carrying the 77 street arc lights and 500 incandescent, 3,200 pounds of coal were consumed. As soon as sufficient data can be secured to show the cost of lighting per year the same will be published in these columns. The plant is in direct charge of a superintendent who makes a monthly report to the city council. In connection with the installation of the plant business methods, quite unlike the usual manner of conducting municipal affairs, have been followed. The installation was promptly completed, promptly tested and accepted, and a settlement was as promptly made.

Some Troubles: Locating and Overcoming Them.

BY CHARLES DESMOND.

Nearly all trouble in the electric lighting plant is due to neglect, or a lack of information regarding the principles and details of the machinery used. In a number of plants where alternating machinery is employed, trouble has been experienced on account of the exciters running hot and the machines not working up to their full capacity. In one particular case of this kind it was noticed that on some evenings the exciter would run cool and the alternator work up to its full capacity and as nicely as could be expected, while on the next evening, probably, the exciter would run very hot and it would be necessary to throw out all the resistance and even then the alternator could not carry the load up to full voltage. As this trouble was not experienced each evening, the cause was a mystery and for a long while baffled those in charge. At last, someone with a more extensive knowledge of the principles, being present at the time the machines were shut down, noticed that when the exciter current was cut off it was done by opening a switch in the exciter circuit.

Opening the switch suddenly in this way produced a strong extra current in the field coils of the machines which, being in a direction opposite to that of the usual excitation, changed the polarity of the field magnets so that the exciter current worked in opposition to that of the auxiliary current from the self-exciting alternator.

In these alternators a certain portion of the current is taken from a commutator, thus straightening it, and making it direct so that it can be used for exciting the field; but it is not enough to excite them to the extent required and neither is it intended to do so. The exciter current is used to produce a certain strength of field to excite the machine primarily and also increases the strength of field to overcome any drop of potential that may occur on the lines; and when the polarity of the exciter is reversed the machines do not work together in the way they should.

To overcome the above defect it was only necessary that the current from the exciter should be allowed to die away gradually, thus preserving the original polarity of the field magnet. This same difficulty has occurred in a number of lighting stations and there are, no doubt, some stations at the present time where the operatives are struggling with the same annoyance.

There is one difficulty that frequently occurs in the handling of T.-H. arc light machines which results in frequent flashing at the commutator. This flashing becomes persistent and is most annoying, as everything about the machine and circuits will appear to be all right so far as the ordinary tests show.

The machine will start up all right and run nicely for a short time when, in some cases, the commutator will begin to cut and the machine begin to flash and will continue to do so until shut down at the end of the run. One cause of such difficulty, which is of frequent occurrence and is often overlooked, is that the screens on the air blower are allowed to become dirty, thus closing the apertures so that an insufficient supply of air is obtained, not enough to blow out the arc which forms between the commutator segments—this is the cause of the flashing, by the current bridging over from one segment to another because there is not sufficient blast of air.

Another difficulty which occurs with the same device is that the oil holes sometimes become closed and the friction in the blower heats it to such an extent that warm air and vapor is blown on to the commutator. The warm air is a sufficient conductor of electricity so that it provides an opportunity for the arc to form, which it does immediately, and the consequence is a flash.

A commutator seldom gets hot unless the shaft becomes over warm and this is generally heated from the bearings when such trouble occurs. When the commutator becomes hot it will vaporize, to a certain extent, any oil, shellac, etc., that may have been used in, or on, the commutator. This warm vapor, being a fair conductor, allows the current to jump across the insulation, forming an arc which often extends around the commutator, producing a flash and putting out the lamps, for an instant.

Flashing occurs much more frequently on arc than on incandescent machines, for the reason that the potentials carried are much higher. A defect that will cause flashing on an arc machine would produce nothing noticeable in the workings of a low tension machine, although the same neglect had allowed parts to become dirty or bearings to become warmer than they should.

Some dynamo attendants make a practice when feeling of bearings to ascertain whether they are warm, of placing their fingers on the cap of the bearings, instead of on the bottom as they should. A dynamo shaft works altogether on the lower bearing and sometimes the cap is set on liners which are non-conductors of heat. In such case the shaft and lower bearing might become quite warm without the cap showing any noticeable rise in temperature. For this reason it is always advisable that the attendant should always feel of the lower bearings to ascertain if they are becoming warm; and many a superintendent or electrician would save himself considerable annoyance with flashing machines if he will direct the attendants to look particularly to this point.

Another cause of flashing, on one particular type of arc machine, is too great an accumulation of oil on the commutator, or rather on the lower brushes, for this is where it gathers, until the amount is sufficient to fly off in large drops. An accumulation of oil at such point will, by bridging over the insulation or air space, cause flashing as soon as the oil becomes warm. This it will do because the oil is interposed between the brush and commutator segments and by reducing the electric conductivity cause heating. This can only occur from oversight or neglect and can be easily removed when noticed. Verily, cleanliness is next to Godliness in the electric light or power plant.

Obituary—Jacob L. Barclay.

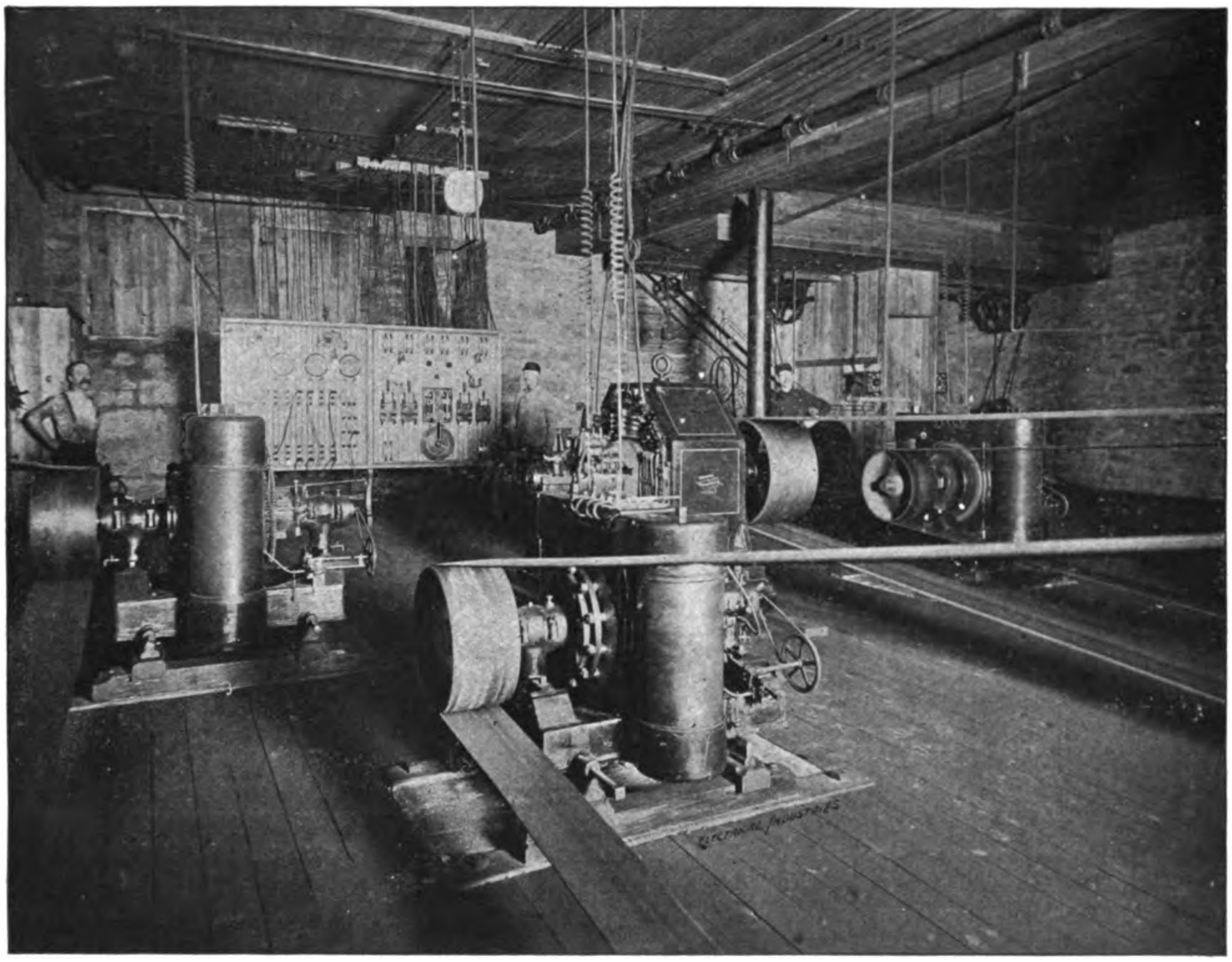
It is with the deepest regret that the many friends of Mr. J. L. Barclay learned of his sudden death on the 26th instant. He possessed a large acquaintance among street railway men extending across the continent, and his death removes one of the most successful salesmen in that field. Born in 1859 he was just in the prime of life. His successful business career commenced in the employ of Holmes, Booth & Haydens where he remained a number of years, and established a reputation as salesman. While representing the above firm he took the Western agency of the Sprague Electric Railway & Motor Company, and sold equipments to a number of large roads. He retained the agency of the Sprague company until it was absorbed by the Edison company. As western manager of the railway department, which he took after giving up the above agency, of the Westinghouse Electric & Mfg. Company, he greatly enlarged his acquaintance and extended his knowledge of this important industry. About one year ago he resigned his position, and at the time of his death was the western manager of the Walker Mfg. Co., which has just entered the electric railway field. Mr. Barclay expended his best efforts in preparing for the new business of the company. A suite of offices had but just been finished in the Monadnock block for the use of the western department. This new venture promised a most successful career, and his sudden taking off is doubly sad both for what the past had given and what the future promised.

JACOB L BARCLAY.

Electricity in a Minneapolis Dry Goods Store.

"A city in itself," is a phrase that is well applied to the great commercial institutions of our large cities known as dry goods stores. The army of employes and throngs of customers are greater in number than the inhabitants of many cities. In the sale, display and distribution of the immense quantities of merchandise daily handled, electricity is a general servant. Its use in this industry has greatly extended during the past year or two.

The recently built Palace dry goods store of S. E. Olson & Co., of Minneapolis, Minn., is probably as well equipped with electrical apparatus and devices as any similar store. Electric cash carriers, electric elevators for both passengers and freight, electric motors for every kind of power with an elaborate system of electric lighting for decoration and illumination, comprises the equipment. The electric current is supplied by an isolated plant in the basement. The main parts of the store are lighted by arc lamps, which are so distributed as to give a good light in every part of the store. The arc lamps are the well known "Standard" double service lamps, suspended from "Standard" hanger boards. Ground glass globes are used on both the interior and exterior lamps. The outside lamps are suspended from bracket arms, one before each show window. The wiring has been done in a very careful manner, and every precaution in the shape of cut-outs and concealed work to prevent any accident in the operation of the system.



ELECTRICITY IN MINNEAPOLIS DRY GOODS STORE.

The incandescent lamps are used for window lighting, ornamental lighting and the offices. The building, when all lights are on, presents a most brilliant appearance, both from within and without; 180 arc lamps are employed. The incandescent dynamo has a capacity of 800 lights, a greater or less number of which are used as the occasion demands. The generating station has been made as complete as possible in every respect. The arc lighting system is that of the Standard Electric Company of Chicago. Four dynamos are used, three 50-light and one 30-light capacity, belted to engines. The entire plant was installed by the Electrical Engineering Co., of Minneapolis, the northwestern agents of the Standard Electric Co.

Territorial Restriction on Edison Lamps.

Judge Lacombe denied the motion to punish for contempt in the case of the Edison Electric Light Co. vs. Robt. Stafford et al (the Imperial Hotel, New York). Some time ago the General Electric Company secured a decree enjoining the proprietors of the Imperial Hotel from using other than Edison lamps. Edison lamps have since been used but have not been purchased from the licensees for the territory in which the hotel is located. The General company then moved to punish the proprietors for contempt with the above result. The following is an abstract of the memorandum filed by the Court:

> "The additional affidavits show that the lamps of the Edison pattern used by defendants have been obtained by them by purchase from three sources. 1. McLeod, Ward & Co., dealers in the electrical supplies in the city. 2. The Jaynes Electric Co., a copartnership in Buffalo dealing in such supplies. 3. The F. P. Little Electric Construction & Supply Co., also in Buffalo.
>
> "1. The first-named firm bought the lamps from the Edison General Electric Co., and its successors the General Electric Company, exclusive licensees to manufacture under

the patent. McLeod, prior to such purchase had signed an agreement binding his firm not to sell any of the lamps so bought in violation of the various obligations which existed between the company and its licensees, and further agreed to keep himself informed of such obligations. The lamps in question were bought from the Edison company upon an order of the firm, stating that they were "for use above 70th St." The were sold to defendants by McLeod without restriction.

"2. The Jaynes Electric Co. bought the lamps it sold to defendants from the Buffalo General Electric Company. This corporation obtained them from the General Electric Company, under a contract which authorized it to sell such lamps only to users of lamps within the county of Erie, except Tonawanda. The Jaynes company bought the lamps from the Buffalo company without restrictions, and sold them to defendants in like manner.

"3. The F. P. Little Company bought the lamps it sold to defendants from the General Electric Co., through its Syracuse agent. It had previously signed an agreement similar to that executed by McLeod, but in making the sale the defendants imposed no restrictions.

"No doubt the defendants were advised in a general way that the complainant, the Illuminating company, claimed that it had the sole right to use, and sell for use, lamps of the patent within the City of New York, but there is no season for discrediting their statements that as to these particular lamps they had no notice or knowledge of any restrictions placed upon those who sold them. Under these circumstances I am of the opinion that under the principles laid down in *Adams* v. *Burke*, 17 Wall 453 and *Hobbie* v. *Jennison*, 149 U. S. 355, the defendants have the right to use the lamps they bought anywhere in the United States. Concededly they were made by the General Electric Co., the exclusive licensees under the patent, and were sold by it to persons to whom it had the right to sell. The last-cited case reiterates the proposition that the "sale of a patented article by an assignee within his territory carried the right to use it everywhere. * *

"The dissentients in *Adams* v. *Burke* and many Circuit Judges in subsequent decisions clearly and forcibly pointed out the result of such a construction of the patent laws, as would leave a patentee, who wishes to divide his rights territorially, dependent upon the good faith of those to whom he sells. But the Supreme Court has so held, and there is nothing for this court to do but to conform to such decision. * * The purchaser of lamps once sold by the patentee, or the person whom he authorizes to make and sell them, cannot under the decisions *supra*, be charged with knowledge of the restrictions upon re-sale which are matter of agreement between the patentee of the licensed manufacturer and the first purchaser. Motion to punish for contempt is denied.

Manufacture of Incandescent Lamps.

In the case of the Edison Electric Light Co. et al. (The General Electric Co.) *vs.* The Universal Electric Co. et al. of a restraining order was secured on September 15th, 1893, soon after which a preliminary injunction was issued which has remained in force until the recent decision of Judge Ricks in the circuit court of the United States for the Northern District of Ohio. On February 9th the defendant filed its motion asking for a dissolution of the injunction. The following is an abstract of the decision of the court:

It is conceded by the defendant's counsel that this motion is as close a copy of the similar motion filed by the defendant in the case of the complainants against the Buckeye Electric Company, recently passed upon by the court, as the facts of the defendant's case will permit, and that the reasons for asking for a dissolution of the injunction in this case are the reasons upon which the motion was allowed in the Buckeye case, so far as the same are applicable to the facts set forth in defendant's motion, and in the affidavits in support thereof.

The facts relied upon in the case to entitle the defendant to a dissolution of the injunction are taken from affidavits, original and supplemental, of N. S. Possons, the president and General Manager of the defendant. They are more specific than those set out in the motion.* Affiant says that he is informed and believes that, before the defendant organized as a corporation, the second claim of the Edison patent had been sustained by Judge Wallace; that he and his associates had been advised that this decision had been at once appealed from, and the defendant company, having been organized, engaged in the manufacture of said lamps pending said appeal, and continued increasing its investments upon the faith of the invalidity of said patent, and its expiration in 1893. Upon learning of the affirmation of said decision of Judge Wallace, it discontinued and did not manufacture until Judge Hallet refused an injunction, application for which was made before him, against a defendant in his district, when it again manufactured until Judge Seeman's decision in the Oconto case, when it closed, and was so closed at the time the restraining order was issued in this case. Affiant avers good faith in the acts and conduct of the defendant; that all its tools purchased for the manufacture of said lamps, and all the appliances connected with its works, would be valueless unless it is allowed to proceed in the business for which it was organized. These, are, briefly stated, the facts upon which the defendant's motion for a dissolution of the injunction are based.

In the case now under consideration, the Universal Electric Company was organized in August, 1892. Judge Wallace's decision affirming the validity of the Edison patent had been promulgated over a year prior to the date of its organization, and only a few months after its organization that decision was affirmed by the United States Circuit Court of Appeals for the Second Circuit. So that, although an appeal had been taken from Judge Wallace's decision at the time the defendant organized, it began the manufacture of an infringing lamp after the patent had been declared valid by a Circuit Judge of high authority. It was hardly more than in operation when that decision was affirmed by the court of last resort for such cases. Its increased investments set out in its motion and affidavits seem to have been a nine thousand dollar increase made in December, 1092, and January, 1893 and an additional increase of $10,000.00, made after the meeting of the directors of the defendant company in May, 1893. The proof is not clear or satisfactory on this point, but giving to the defendant the benefit of the facts averred in its motion. The last investment of $10,000, was made after the complainant's attempted revocation, in March, 1893, of the dedication or grant to the public, made by the proceedings of December 1883. * *

In the Buckeye Case, while the court declined to say just what rights the public acquired as against the owner and assignee of the Edison patent by virtue of the voluntary limitation put upon its life by the Patent Office proceedings of December 1883, it did find that the Buckeye company acquired rights by virtue of the complainant's conduct and acts in connection with such proceedings, and that as to the Buckeye company, the attempted revocation of March, 1893, was of no effect, because the Buckeye company had made all its investments and business arrangements prior to such revocation, and thereby acquired vested rights which could not be disturbed. But in the case now under consideration, the defendants, unfortunately for them, occupy no such favorable attitude. They began business as an infringer, and of their two additional investments (if two were made), the last was certainly made after the revocation of March 1893. * * For these reasons, I do not think the defendant has made a case entitling it to dissolution of the injunction now in force.

Having decided the case upon the facts, and for the reasons hereinbefore stated, it does not become necessary to notice the further contentions made on behalf of the complainants. * *

The motion to dissolve the injunction is therefore disallowed.

Electrical Industries.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

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OUR NEW DEPARTURE.

Beginning with the current issue the directories of Electric Light Central Stations and Electric Railways, which have from the first number formed a special feature of this journal, will hereafter be published in separate form once in three months revised and corrected to date of issue. This change has long been contemplated and is made necessary by the great increase in the number of plants, and the fact that we shall add to these directories as soon as ready a directory of Isolated Lighting Plants now in preparation.

Our honest efforts in the past to furnish the trade with complete and reliable directories of the various interests we represent have, we feel sure, been fully appreciated as the abundant success of this journal can testify, and in thus expanding our directory field we have the assurance from all quarters of the hearty support of subscribers and advertisers, a fact which fully demonstrates that our further enterprise is also fully appreciated. The convenient size of the new publication will especially commend itself. Additions and changes will be made monthly in the regular issue of Electrical Industries, a fact which will more than ever enhance its value and make it indispensable as heretofore. The paper will still contain its complete Buyers' Directory of Manufacturers and Dealers, a feature that will as before make it invaluable to all buyers of electrical apparatus and supplies.

In making this change Electrical Industries will gain a new impetus and will thus appeal to a larger clientage than ever before with nothing to interfere with its securing the largest possible circulation that has always been our ambition to obtain. Its editorial policy will be maintained in every way and no effort or pains spared to improve its reading pages. Arrangements have been made with well known writers in the electrical field, who will contribute from time to time thoroughly practical papers on all branches of electrical work and practice.

We also inaugurate a departure in putting the subscription price of the paper for a time far below the actual cost, but we yield to the demands of the times and have determined to place it within the reach of every one who wishes to be informed on the electrical progress of the day. The popularity and influence of the paper will thus expand and our subscribers, we are confident, will multiply in a many fold ratio. In this way we shall hope in the fullest sense of the word to indeed give the "greatest good to the greatest number."

When competition does not demand it, the endeavor to increase profits encourages every effort to cheapen the cost of production. In the production of electricity for light and power but little increase in efficiency may be expected in either the engine or dynamo of recently equipped stations. The cost of steam delivered to the engine varies with every power house conditioned on cost of fuel and skill of the fireman. Thus for further economies in the cost of production we must look elsewhere. Could the varying load be transformed into a uniform load throughout the period of operation the cost of production would be decreased by a large percentage. Every station manager understands this fact and he also knows that could he shut down entirely during the hours of very light load the saving would be considerable. Storage batteries are the only means at present available to remedy this difficulty, but they are not as yet looked upon with confidence. Numerous installations, better knowledge of their capabilities and improvements in their manufacture are points in the right direction. The ground covered by the various patents is now well understood so that patent litigation is a remote possibility. The manufacturers are prepared to guarantee the work of their cells and the cost of maintenance, so that the station manager is able from a record of the daily load of his plant to estimate the saving in his station by the use of a storage battery. They are assuming more the character of a standard commodity and less of an experimental character. We may confidently look for greater advancement in this direction during the coming year.

The benefits derived from industrial exhibitions are appreciated in every country. In the newer countries of the world they have drawn the attention of the older to their resources and development, promoted and fostered industry, and stimulated and extended their commercial relations. Among the international expositions of the near future is the Tasmanian International Exhibition which is to open November 15th next and continue six months. It is held under the immediate patronage of the government of Tasmania. Substantial buildings are being constructed at Hobart town, which is the principal seaport of the island, for the accommodations of the exhibits already promised from Great Britain, the continent of Europe, India, the Australian Colonies, etc. In easy communication with Hobart, in Tasmania, Australia and neighboring islands there are 4,000,000 people among whom American manufacturers might find sale for more and a greater variety of goods. American electrical apparatus has found customers in almost every part of the globe along with American engines and other machinery. The advantages offered at this exposition are worthy of investigation as opening the way for an extended trade in these Colonies. The business of the exhibition is in the hands of a company composed of business men of Hobart and vicinity which has established agencies in the principle foreign countries. The agency for the United States has been placed with Woltman, Keith & Co., of 11 Wall St., New York, who are prepared to handle any freight or other business for exhibitors in the United States. All electrical apparatus and appliances are arranged in group XI. Space is charged for at a rate of 25 cents per square foot. Goods must be entered by May 1st and be in New York ready for shipment by July 1st.

THE use of the electric current in the arts is rapidly extending, superceding many cumbersome and expensive methods. Iron, although one of the cheapest and most serviceable metals, has one great defect—its rapid oxidation in the open air. To remedy this defect many processes have been employed for covering the iron with a non-oxidizing material to protect it from the air. Probably the most successful method has been the galvanizing process which has been generally used, especially with wrought iron. It is used not only with the sheets but also with manufactured articles of iron. The process is expensive on account of the cost of the necessary plant, the immense body of zinc required to be kept in a molten condition and away from the air while at so high a temperature, the large amount of waste, etc. There are also many difficulties in the process, that of securing an even coating over the surface of the iron, the danger of destroying the temper of the smaller bodies of iron, the liability of the zinc cracking off when the iron is bent sharply, etc. In improving this process and also in experiments on electro-zinc plating a large amount of money has been expended but a process has been recently perfected which it is said will entirely transplant these older methods. This is known as the electro zincing process. The plates, which may be up to 18 feet long, are first pickled, then passed through a washing tank, then to the plating bath. The cost of production is very much less than the older process. The plates are coated evenly and are not warped in the process.

THE rapid growth of our large cities has kept the question of pure water and the proper disposal of sewage prominently before the public. A large part of the annual expense is for what is expended in keeping the city in a good sanitary condition and providing it with a supply of pure water. The difficulties encountered are often greatly increased by the growth of large suburban towns, often in the vicinity of the water supply. In the purification of sewage electricity has become an important agent of the health department. The construction and successful operation of the electrolytic purifying plant at Brewster, N. Y., for the purification of the sewage has brought the subject to the attention of many city governments. The expense of the plant limits its use to the neighborhood of the coast where the sea water is used. Improvements may, however, be made which will allow its use in inland towns.

THE recent report of the Milwaukee fire insurance patrol shows a total for the year of 645 fires from various causes. Chimneys, oil lamps, stoves, furnaces, gasoline, spontaneous combustion, etc., caused 526. The balance were ascribed to unknown causes. Electricity is not credited with any, although some of the unknown may have been so caused. Such a report is quite out of the ordinary, as in the usual report all the unknown and a few more are laid at the door of this "common enemy." If the wiring rules now generally adopted are followed in electrical construction it is difficult to see how fires can occur from this cause. Electricity has gotten an unenviable reputation among certain classes, partly deserved but largely because it was an easy place to lay the blame. To remove this undeserved reputation as stringent rules should be followed in the smaller cities and towns as in the larger. If the town does not provide a system of inspection the central station supplying the current should inspect the electrical work before making connection. If the station does construction work it should follow the same rules it requires others to follow. The rules adopted at the last convention of the National Electric Light Association are probably as equitable as any compiled. The rules adopted by the various insurance companies differ widely in the different localities. It is the intention of the association to secure the adoption of uniform rules, and thus secure a uniform class of good work. The rules of the association have been compiled by committees composed of men of experience who have received in the work the aid of the best American and foreign practice. The rules have been placed before the practical men of the country for their criticism, and as finally adopted and issued by the association are certainly the most complete rules so far published. Their arrangement is such that the rules regarding the different systems of electrical work are easily referred to and are clearly and concisely stated.

CONSIDERABLE attention has lately been given by the daily press of Chicago to the subject of rapid transit in the center of the city. The elevated roads now in operation and those in process of construction fail to reach by several blocks the center of the city. A person from one section of the city in going to another section is at the present time dependent upon the surface roads unless he wishes to walk a considerable distance in going from one station to the other. To form a connecting link, as it were, between these stations, the stations of the steam roads, the principal hotels, theaters and other places in the center of the city a number of plans have been proposed for a belt line. In nearly all electricity is the favorite motive power. The moving sidewalk plan seems to have a good many supporters and a number of different methods of utilizing that idea have been presented. A plan for a moving sidewalk under the present sidewalk, another above the sidewalk and still another for a moving sidewalk supported on a single line of columns placed at the curb have been brought to the attention of the public. What is called the property owners plan is among the latest schemes and has received the sanction of a number of important property owners along the proposed line. This plan calls for an elevated structure at the same height as the existing elevated roads and operated similarly to the Intramural at the World's Fair. The proposed road is to encircle the district bounded by Market, Harrison, Wabash and Lake Sts., running in the alley between Wabash and Michigan Aves. and also between Lake and Water Sts. It is doubtful whether any of these plans would entirely fill the requirements. The road would still be four blocks from much of the enclosed district and its patronage would come almost entirely from passengers on the elevated or steam roads. Whether such a road could pay independently, is considered doubtful. Some plan, however, will undoubtedly soon be perfected of reaching the center of the business district from the elevated railway stations.

The great drawbridge on the New York, New Haven & Hartford R. R. over the Bronx River, at West Farms, is to be 200 feet long. It will have four tracks and will necessarily be an immense structure to open and close. It is now contemplated to use electricity for this purpose. There is at the present time an electric railway power house in the vicinity where with slight changes the electricity can be generated.

Polyphase Transmission.—Concluded.*

BY CHAS. F. SCOTT.

This E. M. F. corresponds very closely to the E. M. F. required for sending current through a short circuited line and in ordinary transformers is practically equal to the counter E. M. F. and may be considered equal to it.

A transformer may be taken for experiment in which the E. M. F's are 1000 volts and 100 volts. If 5 volts, or ½ per cent is required for sending through the primary a continuous current equal to the normal full load current of the transformer, and if a similar E. M. F. in the secondary is ½ a volt, or ½ per cent, then the ohmic loss in the transformer is 1 per cent and the drop in pressure at the secondary terminals between no load and full load will be 1 per cent if the self-induction be negligible. If, however, there is a self-induction so that 100 volts, or ten per cent is required for sending the normal current through the primary when the secondary is short circuited, then the drop in pressure is in general greater than 1 per cent, depending principally upon the character of the load. The load may be non-inductive, as lamps, or it may be more or less inductive. The experiments described above, in which a line had the same per cent ohmic and inductive characteristics as the converter just described, apply to the converter as we'l as to the line. The drop on such a converter therefore may vary from 1½ to 10 per cent when delivering its rated current. Arc lamps or fan motors will produce a very much greater drop than incandescent lamps. The power factor of an alternating current arc lamp varies considerably, but in a number of cases has been found between 85 and 90 per cent. The drop when incandescent lamps are replaced by arc lamps on the transformer just described increases from about 1½ to 5 or 6 per cent.

A secondary line, if it carry a large current, may have a counter E. M. F. of several volts. This may not be enough to increase appreciably the drop in the line between the transformer terminals and incandescent lamps. But the transformer, however, delivers current to the secondary circuit and to the lamps, so that the regulation of the transformer may be affected by the self-induction of the secondary circuit. Cases have occurred in which transformers of a very old type possessing high self-induction were supplying very large secondary currents and the resulting drop in the transformers was increased several per cent. For example, a circuit of No. 0000 B & S wire supplying 100 amperes to 50 volt lamps at a distance of 100 feet has an ohmic drop of 2 per cent. The constant for counter E. M. F. of this circuit, if the wires be 6 inches apart, is .022. The volts at 16,000 alternations are .022 by 100 by .1 by 16 = 3.52, or 7 per cent of 50 volts. The inductive drop in the line corresponding to 7 per cent is .25 per cent. The power factor of the aggregate service of the transformer is the second side of a right angle triangle of which 7 is one side and 100 is the hypothenuse. This is 99.7, which is the power factor of the load on the transformer. If the self-induction of the converter be 10 per cent, the inductive drop is 1.2 per cent; if 20 per cent, the inductive drop is ¾ per cent and if 30 per cent the inductive drop is 7 per cent. The aggregate drop in the converter and secondary circuit in the latter case would be, say 2 per cent for ohmic drop in transformer, 2 per cent ohmic drop in line, 7 per cent inductive drop in transformer and .25 per cent inductive drop in line, or a total of 11 25 per cent. The necessary ohmic drop is 4 per cent and the inductive drop resulting from self-induction in transformer and line is therefore 7.25 per cent. If the number of alternations be reduced to 7,200 the inductive drop would be reduced from 7.25 per cent to 1½ per cent.

The practical bearing of the self-induction of a transformer upon its regulation and the exact relation between the two does not seem to be clearly recognized, and even Dr. Hopkinson and Dr. Fleming, who have made very exhaustive tests upon transformers, comparing different methods of testing the different types of transformers, have not brought out this point. Attention is given to the exact form of the current wave, and measurements upon the iron losses are attempted within very close limits of error. Their measurements upon the regulation of the same transformer, however, vary from 2 per cent to 2.4 per cent, or one measurement is one-fifth greater than the other. The presence of slight induction in the secondary load would have caused a very considerable increase, and it is probable that the difference in the measurements made were due to difference in the self-induction in the instruments used or in the load at the time the tests were made. No note is made of the effect of the self induction of the load upon regulation although regulation is one of the most vital points in the practical use of transformers. Even the temperature at which the drop was measured is not stated although the resistance of a transformer when continuously working may be 20 per cent greater then when cold. The elements of practical importance in a transformer are (1) the iron loss, in respect to the efficiency, (2) the regulation, in respect to the satisfaction of service; and (3) the temperature to which the insulation is subjected, as affecting the life of the transformer. The ordinary tests by theoretical men, however, usually take into account only the iron loss, which is measured to a very high degree of accuracy, although the iron loss in transformers is the one thing which cannot be controlled and is certain to vary 10 or 20 per cent in commercial manufacture. The full load efficiency is usually given as if it had a great deal of importance whereas the losses in copper during 24 hours ordinarily amount to but a trifling per cent of the total losses. The regulation, and the temperature to which the insulation is subjected and which it is able to stand are generally not mentioned in reports of tests. The usual investigations upon transformers and the papers published refer more to interesting theoretical points than to those of immediate practical importance. The regulation may perhaps be accurately expressed in complicated formulæ in treatises on the alternating current transformer, but the practical bearing of these points in every-day working seem to be totally ignored.

If two circuits be run on the same poles they act as a transformer in which one circuit carrying current may act as a primary and induce E. M. F. in the other as a secondary. If the latter circuit is connected with the same dynamo and is delivering current, its E. M. F. will be slightly raised or slightly lowered by the effects of the first circuit. Conversely, the second circuit will have similar effect upon its neighbor, raising or lowering its pressure by a slight amount. If the two circuits be connected to different dynamos which are running at slightly different speeds, then the E. M. F. induced by one circuit upon the other will sometimes increase and at other times decrease the E. M. F. of the circuit, depending upon whether the two currents at a given moment are flowing in the same or in opposite directions. This fluctuation may cause variations in the intensity of the lights supplied. It is readily detected in the service of some central stations, and is of course most marked at times of full load, as the induction of one circuit upon another depends upon the strength of current carried. The fluctuation due to this action may be readily detected from that due to slipping of belts or irregularity in engine speed, as the induction effect is due to the difference in alternations between two machines, and the speeds of the two machines are apt to vary slightly from time to time, giving a gradual variation in the rate of fluctuation of the lamps. The number of volts E.M.F. set up in one circuit by a parallel circuit depends upon the current, the distance which the lines are parallel and upon the relative positions of the four conductors. The distance between wires may be six inches or six feet without affecting the mutual induction, provided the relative positions be unchanged. The number of volts required for producing objectionable flickering in the light depends upon the voltage of the lamps in service, the efficiency at which they are run and the general surroundings in which they are placed, notably the relation of lamps to reflectors, white walls, etc., and the general disposition of the customer. An E. M. F. of ½ per cent induced in one circuit by another can in some cases be detected, and usually more than one or two per cent will cause objectionable flickering.

The mutual induction is reduced by bringing the wires in each circuit close together and separating the circuits. The effect of this mutual induction may be neutralized by crossing one of the lines at its middle point so that induction in the first half of the line is counteracted by the induction in the second half. It is readily noted that the effect of self-induction in a

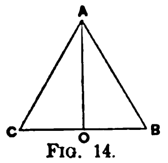

FIG. 14.

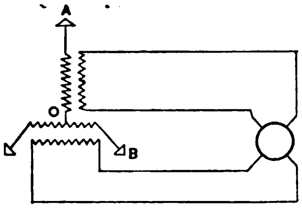

FIG. 15.

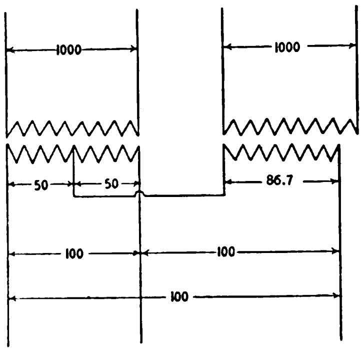

FIG. 16.

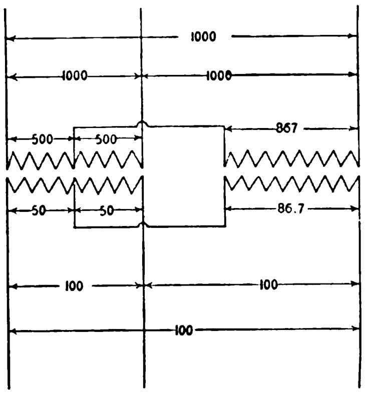

FIG. 17.

POLYPHASE TRANSMISSION.—CONCLUDED.

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*From March number. Read before N. E. L. A. convention.

circuit is reduced as the wires are brought close together or if each conductor be divided into several wires in multiple and separated. The effect of self-induction is diminished as the number of alternations is reduced. The following points are also to be noted in connection with inductive drop. If the power factory be nearly 100 per cent the inductive drop increases as the square of the counter E. M. F. If the E. M. F. of the circuit be increased and the same power be delivered over the same circuit, the per cent counter E. M. F. decreases as the square of the E. M. F. delivered, and the inductive drop decreases approximately as the fourth power. If the number of alternations be decreased the counter E. M. F. decreases directly and the inductive drop decreases as the square. The inductive drop at 7,200 alternations is less than one-fourth of that for 16,000 alternations for ordinary power factors.

The static capacity in ordinary lines is usually small and its effect is not of importance unless the line be very long or the pressure be very high. The general effect of capacity in the line or of connecting condensers to the line is to lessen the current from the generator which is required for supplying inductive load and to reduce the drop due to self-induction. The use of condensers for this purpose may lead to very considerable gains in circuits where the self-induction of line or of load becomes considerable. If an inductive circuit or transformer supply current to condensers the E. M. F. may increase instead of decreasing as it does with inductive load.

The subjects which have so far been considered apply to single-phase as well as to polyphase circuits. The effects of self-induction will be brought to the attention of the electrical engineer much more prominently in connection with polyphase work, however, because larger alternating current enterprises will be carried out with the polyphase system and power work involving variable power factors will be a large element in this system. There are in addition several problems which relate distinctively to polyphase working. One of these is the most suitable number of phases to be used. The two-phase system and the three-phase system are both in operation, and while it is admitted by the adherents of each system that there is no fundamental difference between them, yet each has specific characteristics giving particular advantages.

In transmission it has been recently pointed out by a good many people that the single-phase system and the two phase system require the same weight of copper, and that the three-phase, three-wire system requires 25 per cent less for transmitting power under similar conditions with the same maximum E. M. F. This places an advantage on the side of the three-phase system which in many cases is of very considerable importance.

It has also been shown that the self-induction of a three-phase circuit for transmitting under similar conditions of E. M. F. is only 57 per cent of that which is incident to the single-phase or two-phase system. When the power factor is high the effect of self-induction of line upon regulation varies as the square of the counter E. M. F. The drop due to the self-induction of a three-phase circuit is therefore only about one-third of a single-phase or two-phase circuit. This is a second advantage for the three-phase system which is of great value.

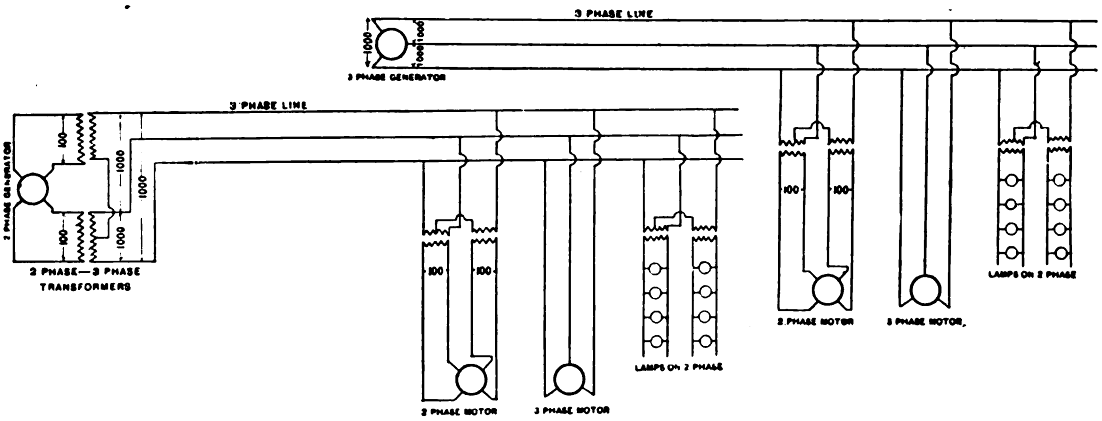

Fig. 18.

Fig. 19.

POLYPHASE TRANSMISSION.—CONCLUDED.

An important point of difference between the two systems is the effect of loading one branch of the system more heavily than the others, as is common in incandescent lighting. One of the statements which remain uncontroverted in Prof. Forbes' recent comprehensive paper upon the Electrical Transmission of Power at Niagara Falls is in reference to the difference of regulation in dynamos for two-phase and for three-phase alternating currents. He gives the result of tests showing that the circuits of a three-phase generator differ greatly in pressure if they are not equally loaded and states that having considered these points the directors of the company determined to reject the three-phase system. These results agree fairly well with tests which I have made. The relative regulation of the two types of machines depends very largely of course upon the character of the construction.

If independent regulation of circuits is necessary, one circuit can be given the proper pressure directly from the dynamo and the other circuits may be raised or lowered as may be required. This involves apparatus for regulating two circuits if the station be operated by the three-phase system and only one circuit if the two-phase system is in use.

In a system where incandescent lighting is to be a prominent feature, or where load of any kind may be required upon one circuit and not on the other, the two-phase system has therefore a decided advantage in station regulation over the three-phase system. Another advantage of a two-phase circuit is that the load is separated into two divisions instead of three divisions, which is in general much simpler. A further advantage of the two-phase is in the reduction of potential for motors. Two transformers are sufficient in the two-phase system whereas three transformers are commonly used in the three-phase. The two transformers which would be required for small motors will cost considerably less than the three transformers which would be required on the three-phase system and the loss in transformation will be much less as there is not much difference in the cost of small transformers of slightly different sizes and the large sizes are more efficient. The ease and simplicity of installation is also a gain for the two-phase arrangement.

In considering the marked advantages of the two-phase system for distribution and of the three-phase system for transmission, it occurred to me that a combination of the two systems might secure the advantages of both in a combined system, and I have worked out a simple and effective method of accomplishing this result. It is well known that if two E. M. F.'s differing in phase be connected in series that the resulting E M. F. will in general differ in value and in phase from either of its components. If two E. M. F's differing in phase 90 degrees be connected in series, the resultant E. M. F. is represented in direction and magnitude by the hypothenuse of a right angle triangle, of which the two sides are the two component E. M. F's. Thus in figure 14, if A O and O B are two E. M. F's at right angles and these E. M. F's be connected in series, the resultant is the line A B, of different phase from either of the components. It is a simple matter to so proportion the components that O B is equal to one-half of A B, as shown in the diagram. In a similar manner it is readily seen that the same E. M. F. O A may be combined with O C, which differs from it by 90 degrees (but is equal and opposite to O B) in such a way as to give A C equal to A B, but differing in direction. O B and O C added together give B C. The E M. F. B C may therefore be combined with the E M. F. A O at right angles to it in such a way as to give additional E. M. F's A B and C. A, which, in connection with B C, give three equal E. M. F's. 120 degrees apart. This is the relation of E. M. F's. in the three-phase system.

The application of this arrangement to transformers is illustrated in the accompanying figures 15 and 16. The primaries of two transformers are connected to a generator giving two-phase current. The secondary E M. F's. therefore differ 90 degrees. One secondary is made equal to 100 turns and a loop is brought out at its middle point giving 50 turns at each side. The second secondary has 87 turns, which is approximately equal to 50 multiplied by the square root of 3. One end of the secondary circuit is connected with the middle point of the secondary of the first transformer, as shown, and the three free terminals will then deliver E. M. F's. differing in phase 120 degrees. If the E. M. F. on each primary be 1,000 volts and on one secondary 100 volts and on the other 87 volts, then the E M. F. measured between any two secondary terminals will be 100 volts. This three-phase circuit is adapted for operating three-phase motors. In a system of transmission two-phase currents at the generator may be converted into three phase currents, as shown in figure 18, and the windings may be such that the E. M. F. is raised for transmission. The currents are then transmitted by three phases, effecting economy in copper. At the other end of the line a similar arrangement of transformers may be used for converting from the three-phase to the two-phase system. The two-phase currents may then be used for the operation of two-phase motors or the circuits may be independently loaded with lamps, or otherwise. If lamps be placed on the transformer which supplies directly from its two terminals the transmission is directly from the generator without affecting in anyway the other circuit as the generator terminals are connected directly to the first primaries, and the secondaries of the raising transformer are connected directly to the primaries of the lowering transformer and the current from this is taken directly to the load. On the other hand, if the other circuit be loaded the action here will also be on its own generator circuit without affecting the first. The current from the raising transformer in this circuit passes to the middle of the secondary of the other transformer, where it divides and flows in parallel through the two parts of the coil and two of the lines. As one-half of the current flows through each part of the secondary coil in opposite directions, the self-induction is completely neutralized and the transformers in this circuit are independent of the operation of the other circuit. It is to be noted that under this condition the line E. M. F. delivered by this transformer is only 87 per cent of that delivered by the first transformer. The lower E. M. F., however, is compensated for by the fact that the current on one side is passed through two of the lines in parallel, thus reducing the resistance of the circuit and compensating for the slightly lower E. M. F.

The effect upon the regulation of the generator when two-phase circuits at the end of a three-phase transmission line are independently loaded is found, both by theory and test, to be the same that prevails when the load is placed directly upon the corresponding circuit of the generator. A modification of this system is found in the arrangement where the three-phase current is produced in the generator and transmitted over three wires to the reducing transformers. These transformers may be arranged as described for producing two phases. Loads may be placed upon either of the two-phase circuits and practically the same regulation in the generator will result that would have resulted if the generator itself had been wound for two phases and one of these circuits loaded. In this way it is possible to place lighting load upon a three-phase generator in two instead of three units and to avoid the bad regulation in the generator due to unequal loading. A similar arrangement of two transformers may be used for converting three phases of one potential into three phases of another potential. This arrangement is shown in the accompanying figure 17.

The efficiency of two transformers arranged for converting from two-phase to three-phase is reduced below that when working independently on ordinary loads by an insignificant amount. If the efficiency in ordinary working is, say 97.5 per cent it would be reduced to 97.4 per cent in converting from one number of phases to the other. The Tesla polyphase system in which the largest electrical enterprises are seeking a realization, adapts itself with marvelous facility not only to all branches of electrical industry, but also by the transformation of its phases to the utilization of three phases for gaining the highest economy in transmission, and of two phases for securing the maximum advantages in distribution.

DISCUSSION.

Prof. Forbes: It seems to me that the two systems, so far as we can find out in practice, as to their economy, etc., have little advantage one over the other. That is the conclusion I have come to, but Mr. Scott and others hold different opinions. If the opinion be right that the three-phase system has a distinct advantage over the two-phase then such a scheme as Mr. Scott's ought to prove of great value. I think if we take this paper of Mr Scott's in conjunction with those which have been written by Mr. Kennelly on the same subject, any engineer has got before him all that is required for calculating the effects of self-induction and capacity upon the circuit; that is to say upon the efficiency of the circuit and upon the dropping volts on the circuit. A little more has to be done, however, and that is the effect of resonance. The question of self-induction in the circuit is too full. We first have to deal, as Mr. Scott pointed out, with the whole circuit as forming one loop within which lines of force are formed which cut both conductors, and therefore produce E. M. F., and then you have to consider the back E. M. F., which is induced in the conductors themselves. Now, if we have a conductor, an inch in diameter we will say, if that were built up of a number of wires a current suddenly started in these would induce a back E. M. F. in each of the others, and, therefore, every one of these wires would be acted on by others, but it is obvious that the central wire of the bundle would be acted upon more by the others than any other; and, therefore, the back E. M. F. would be the greatest in the center of the bundle. Instead of a bundle of wires we have a solid conductor, but the effects remain the same and the back E. M. F. in the center of the conductor prevents the current from passing through the conductor and as it has to pass over the outside of the conductor there is a resistance to the passage of the current, and that is the skin resistance. These two elements have to be taken care of, and also the question of capacity. Capacity may tend to diminish the drop in the line. Now in regard to the lines of force that are formed in the loop of the circuit, as a matter of fact even though E. M. F. produced by this line of force, being enclosed in the circuit, even though that E. M. F. may be considerable it does not necessarily imply that the whole of that E. M. F. is taken off from the applied E. M. F. That is to say, suppose we found in a long circuit, going from Niagara to Buffalo, that there was a 1,000 volts in the circuit due to this self induction, that does not necessarily imply that there is a drop of a 1,000 volts, because from the sketches which Mr. Scott showed you the E. M. F. is not in phase with the current. In fact, the chances are that it is nearly 90 degrees away, and therefore, the actual drop is much less than that. But here is a case which we have to consider and which is of the utmost importance. Mr. Scott has spoken of the interference of separate circuits upon each other. If he had considered the question of these circuits, two different circuits, being the circuits of a two-phase circuit of a distribution, one circuit being a quarter of a period behind the other then we have a very serious interference. Suppose this current is changed from positive to negative. At the moment when it is zero there is a maximum electro motive force cutting the field and that maximum electro-motive force cuts the other conductors which carry the current a quarter of a phase behind, at the very moment when that current is at its maximum. Therefore, the E. M. F. induced by one circuit upon the other is in phase with the current in the other conductor, and the pole of the electro-motive force thus generated is a drop in the E. M. F. of the other circuit. For this reason you will see that it is the utmost importance in a large station where the polyphase system is employed to consider most carefully the arrangement of the conductors in your subways or on your poles; so that the interference of one circuit upon the other shall be a minimum. This interference between the two circuits is of very great importance, far more important than the self-induction of one of the circuits upon itself; and it is largely owing to the trouble that may arise from this and largely owing to the trouble which may arise from capacity, that I have to look most carefully into the subject and have found the lower frequency the less do these things trouble us. It is largely, I say, owing to these reasons that we determined at Niagara to reduce in our dynamos the frequency to as low a point as was consistent with the construction of good, sound generators; and that is largely the reason why we have reduced our frequency to so low as twenty-five periods a second.

Prof. Rowland: Gentlemen, it is with great pleasure that I rise to say a few words with regard to this invention of Mr. Scott's. As far as I can see, it is one of the finest things that have come out in recent years in this country. Very few of us expected that we would be so soon able to transform a two-phase system into a three-phase, or any number of phases. It gives us possibilities in the working of motors, etc., which we had not before, and I think this paper marks an era in the science of the polyphase system. It is curious that I happened to be writing a paper at the present time upon something on this very subject—the subject of transforming one number of phases into another number, that is, two phase into three phase, etc. I think I have also solved the problem of transforming any polyphase system into any other polyphase, also with any different period of the current. That is a little broader than this is; at the same time, my method is not in any way so practical as this, and is not so simple, and in no way bears comparison with it. It has, however, a little broader aspect, as I can change the period of the current at the same time that the number of phases is changed. It is not, however, practical, like this beautiful method of Mr. Scott's.

Mr. Stillwell: I have been pleased to note the interest which those members of the association who are managers of central stations have taken to Mr. Scott's paper. The paper is especially important in view of the fact that we are just now approaching the time in this country when there will be a necessity to supply arc service and motor service from our incandescent circuits. Many of you have already felt the pressure which is being exerted to drive you underground with your circuits. When that time comes the importance of being able to supply all kinds of service from one system of conductors will be great.

Development of the Switchboards for Modern Central Stations—Concluded.*

BY A. B. HERRICK.

The popularity of the field is always the same and cannot be reversed. In bus-exciting of large multipolar dynamos the taking of the field off the bus introduces into a system of low potential a high potential discharge, which submits the field insulation to a strain which can be avoided in several ways. One method is by having a special switch, which, before severing the fields from the bus, connects the fields in such a way that it is divided into two halves, the electro motive forces of discharge are opposed against each other and consequently die away without having any effect.

The disadvantages of the bus-exciting method are, 1st: That in case the system is short circuited sufficient potential cannot be generated to burn out the short circuit; 2d: If the dynamo is operated on a different bus from which it is excited full output of the machine cannot be obtained in case the exciting potential is lower than its working potental. * *

A word in regard to temporary work in stations would not be out of place here. A great deal of temporary work done, especially in switchboards, is a reflection on good engineering. There is no reason, with foresight on the part of the designer, why a great deal of this work could not be obviated, thereby saving labor and capital being expended which has only a short period of dividend earning capacity and on which expenditure a dividend has always to be earned as long as the plant is in existence.

The iron framework is the best for switchboards construction when constructed with standard steel channels and T's. The framework is made in sections and can be readily taken down, and where it is secured to any metallic portions of the station building, it should be carefully insulated from it. The frame is usually set on the top of the slate floor, which makes a very serviceable flooring for a gallery, and all bolts going through the iron framework of the switchboard should be insulated where they are in contact with the beams under the floor. With a grounded neutral the insulated iron framework has great advantages, both in regard to leakage and in working behind the board. A four foot space should be allowed between the walls and the switchboards for convenience in working and erecting.

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*From March number. Read before the N. E. L. A. convention.

In the case of a switchboard carrying different potentials, such as arc light, railway and incandescent circuit, the different parts of the iron framework are also insulated from each other. The material best adapted for the switchboard slabs can be carefully tested slate, a chocolate colored fine grain Tennessee marble or light gray marble used largely in the west. Italian marble is very good and makes the most effective switchboard, and if care is exercised in keeping it clean, it is very durable. Tennessee marble of the proper quality should drill nearly as readily as slate and is the most durable of all marbles.

A line of porcelain insulators is very convenient for station wiring for bare cable and copper rod, which can be built up in any form to lead the conductors through the station, either on iron framework or recessed in the wall. The cost of station conductors can be cut about 20 per cent. by the use of bare conductors. Solid copper rod on porcelain insulators gives very high insulation, and in exposed places can be served with asbestos twine, which affords the conductors protection from mechanical injury, and fire cannot be transferred along the conductors to other parts of the building. A welding machine is very useful in connecting the adjacent lengths of copper rod, and provision for expansion is made at the elbows by a flexible laminated "L." Bus bar supports are also made of porcelain, doing away with all inflammable material in the switchboard and for the wiring of the station, and reducing the insurance risk on this class of property.

It will also be noticed that all conducting parts and switch-contacts are made more massive than in the old type appliances. The economy of this is very apparent; for instance, if a thousand ampere switch were used which had an average elevation of temperature of 20 degrees Fahr. above the average air temperature of the station, this would mean an average loss of 72.2 watts, and with electrical horse power delivered at $60 per year, the energy expended in heating this switch would cost nearly $6 per year. From this it is evident that a switch possessing more material and contact surface would be a very economical investment. These points of sufficient carrying capacity unfortunately do not become evident until the station becomes fully loaded.

If any part of the switchboard passes an average of 20 degrees Fahr. above the surrounding air, the high water mark for economy has been passed in the design of this board, and it is unprofitable to pass the current through devices whose temperature averages more than 20 degrees Fahr. In this case the manufactured product of the station is uselessly wasted in its transmission. It should be utilized for earning dividends by passing it through the meter of the consumer instead of wasting it in the station.

DISCUSSION.

Mr. Weston: Some one has said that whatever is, is right. Most of us that have lived very long have failed to appreciate the truthfulness of that statement. I think if the author of that statement had visited a few of our central stations and examined the switchboards and determined the amount of energy lost in the stations in this country he would never have uttered it. The amount of energy that we have left at our disposal, from that which is actually in the coal, for distribution in the form of electric energy, is so very small that behooves us to take the utmost care to save just as much as we can that we have left for actual useful work. Of that which we have left, we cannot afford to fritter down step by step until a small part of it only reaches our lamps, and that small part is what we get paid for. There are two ways of looking at that matter of loss; first, you may look upon it as the loss of what it costs to produce the energy that you lose; second, you may look upon it from standpoint of what you could get for it if you sold it. To the business man the latter view is by far the more correct and more important, because, obviously if he gets 12 cents, which is about the average, I think, in this country, per kilowatt hour for the energy delivered to the consumer, that which he loses in the frittering away process in the conductors really represents a decrease in his revenues at that rate; that is to say, it represents just so much horse power, and a horse power costs you just so much, figured on the basis of the amount of coal consumed and the attendance required on the steam engine, and that is certainly not right. When you figure the cost of your kilowatts you have to take everything into consideration to form a correct estimate; your expenses are distributed over the entire thing.

This matter of central station switchboards is becoming more and more important every day, and the present board is unquestionably not the practice that will be followed in the near future. It will be totally changed and the appliances proposed by Mr. Herrick will, in the comparatively near future, be entirely abandoned; there is no question about this when station managers begin to realize how much they lose even on their switchboards.

I have made some calculations based on a selling price of 12 cents per kilowatt hour, and I have furthermore assumed that that kilowatt hour is maintained 24 hours a day, 365 days in a year. If you want to modify that you can do it to suit your particular condition. It is comparatively easy to ascertain just about what you are losing; the general practice is to adopt about a million square circular mills per thousand amperes. In ten feet of such a conductor there would be a drop of one-tenth of a volt with a current of 1,000 amperes. Now that looks rather small—one-tenth of a volt; but expressed in dollars and cents at the end of the year it amounts to a great deal. On the plan proposed it amounts to $12.48 for every ten feet of that conductor. If you take a conductor of ten times that cross section and ten times the strength of the current, viz, 10,000 amperes, that it amounts to $1,124 per annum. Therefore, it is better to say that a fall of potential in a conductor ten feet long, of one circular inch, involves the loss of about $100 per year if run continuously. If it involves that loss in that conductor, of course it involves the same loss in any other branch of the conductor—any extension of it. This question of loss at the switches is one that is something amazing. I had occasion a little while ago to examine two switches carrying 8,000 amperes. At the joints of the switch there was a drop of 240 milli-volts; multiply that by the number of amperes 8,000, and you will see that there was nearly two kilowatts in the joints. Continue that two kilowatts at 12 cents an hour during the year and it amounts to thousands of dollars. That was only the joints. There was an actual drop at the switch of 360 mili-volts They want some severe reformation there, that is sure. In the ammeter there was a drop of nearly two-tenths of a volt, with nearly 8,000 amperes, and the total loss in that one instrument and switch figures very closely to $5,000 a year. If there were about 30 or 40 instruments in the station you could see what it would amount to at the end of the year.

The ammeters themselves, every one of them, and the feeder ammeters take a large amount of energy; and everything possible should be done to reduce this loss to a minimum I have selected one examination which shall be nameless. This ammeter was a good deal better than the average so far as efficiency, or economy, more properly speaking, is concerned.

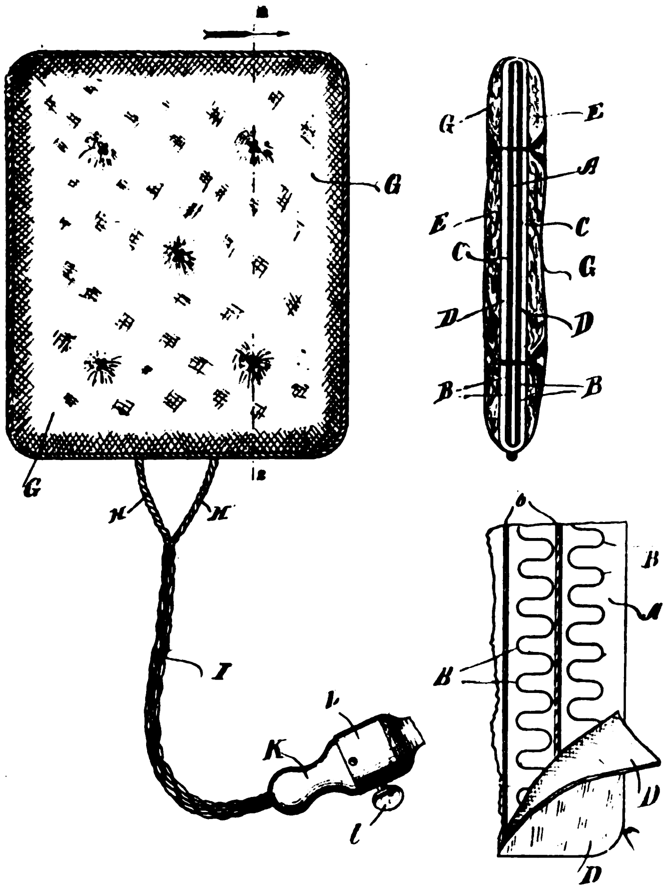
This was a 600 ampere ammeter—a comparatively small one—and in the conductor there was a los of 21 watts. That looks rather small when the instrument was running at its full rate of capacity; it amounts to a quarter of one cent per hour on the basis stated; this is 6 cents a day and amounts to a little over $22 in a year, but if you have ten of these it means $220. But that ammeter had joints in it and those joints were not well fitted, and there was a further loss in the joints which we will leave out of consideration at the present time. To use that ammeter it would require an average of 10 feet of conductor to carry the current to and from it. In that conductor there would be a loss of 64.2 watts; the instrument and conductor together $89 waste of energy on the basis stated. A very good form of ammeter of 600 ampere capacity required 18 watts to operate it; now that 18 watts ought to be got rid of. You can eliminate it if you use a shunt type of instrument properly designed, but do not use a shunt with it—then you derive the full benefits of that type of instrument. Do not use a specially constructed shunt but take the actual necessary drop of potential to utilize it to work the instrument, and the instrument which consumed 18 watts, practically consumes .0021 of a watt and instead of costing $18 per year to run it it cost you .22 of a cent. The result of this is that the switchboard should be brought as near to your dynamos as you can possibly get them; every inch of unnecessary conductor should be left out. Every joint should be left out that possibly can be, and when joints are made they should have large surface contacts. When you make conductors do not make them in circular form, but make them flat. Give the conductor plenty of air so there can be an abundance of the cooling action of the atmosphere.

It is clear that the stations should be so arranged that your feeder circuits are as short as they possibly can be. Your switches must be made very differently from what they are now; polished brass looks pretty, but it is not what you want; do not sacrifice good qualities for appearance. Your conductor should be given plenty of space, they should not be laid flat on one side of the switchboard, placed upon a slab, and closed at the bottom. Keep the temperature of the conductors down as low as you can; I do not know but that it would pay to put an oil bath around your conductors, and cool the oil by water.

Russia is to the American public a country that is but little known. The acts of the nihilists and the sufferings of Siberian exiles comprise the larger part of the information furnished by the press concerning that great country. The immense tracts of undeveloped country and large population unacquainted with the modern industrial arts is a field which Russian capitalists have entered with their railroads and which they are striving to develop by these systems of communication. To American manufacturers especially those manufacturing electrical goods a market will be found there which is sure to grow. The home market has not grown with the number and equipments of the factories and the manufacturers must look to foreign markets for the disposal of the surplus. Russia is already a large buyer of American goods and this trade can be easily extended.

The Nutting Flexible Electric Heater.

The object of Mr. Sam'l E. Nutting's invention illustrated herewith is to provide an electric heater composed of resistance wires imbedded in a non-electric conducting substance, and covered with a flexible covering in such a manner as to protect the wires from direct contact with the air. The whole is light and durable, so that it may be used for all purposes where a hot application is desired. It has been customary heretofore for all hot applications in sickness, or for warming portions of the body, to use hot water, applied in as convenient a way as possible, the objection being that the application cools immediately. The introduction of electricity into so many homes, hospitals, etc., has created a demand for an electric heater to serve the purpose of the needed hot applications under all circumstances so that the application would remain at a constant heat.



THE NUTTING FLEXIBLE ELECTRIC HEATER.

Mr. Sam'l E. Nutting, of Chicago, Ill., appreciated this growing demand and has invented the heater as herein described. No family, or physician, or hospital will be long without appreciating its usefulness. In the illustrations Fig. 1 represents a plan view of the heater. Fig. 2 a sectional view of same, and Fig. 3 a plan view of a portion of the same with the outer covering removed and showing the method of imbedding the wires. In the construction as illustrated in these columns, A is a base formed of a sheet of flexible asbestos material, on each side of which is secured a series of German silver resistance wires; B, arranged in a zigzag manner to compensate for the expansion and contraction of the wire during its heating or cooling.

The wires are separated from each other and prevented from coming into electric contact with each other by means of asbestos cord, B; the space occupied by these wires is filled preferably with solution of silicate of soda, C, and and the whole is covered with another sheet of flexible asbestos material, D. The silicate becomes hardened and acts as a cement to unite the base and outer covering together. This outer covering is then surrounded with a fibrous packing, E, preferably of mineral wool or asbestos fibre. The whole is enclosed in a velvet envelope or covering, G, and secured together by quilting or sewing in any usual manner.

Attached to the terminals, H and H^1, of the resistance wires is an insulated cable which is connected at its other end with an ordinary plug to fit any incandescent lamp socket, or to fit the regulator which is intervened to regulate the amount of heat generated.

From the foregoing description it will be seen the heater is light and portable. The various parts constituting same are formed of flexible non-electric conducting materials so that the heater may be conformed to any desired shape without destroying any of the parts or rendering the heater less efficient. These heaters are being manufactured exclusively by Bartholomew, Stow & Co., 57 Michigan Ave., Chicago, in all sizes from the ordinary household heater, 8 inches by 10 inches, illustrated herewith, up to sizes of a mattress necessary for hospital use in warming or sweating patients. From outward appearance they are soft velvet cushions, but the ordinary household heater given the current of one 16-candle power incandescent lamp is capable of becoming heated so that it cannot be approached to any portion of the body.

The Incandescent Lamp.

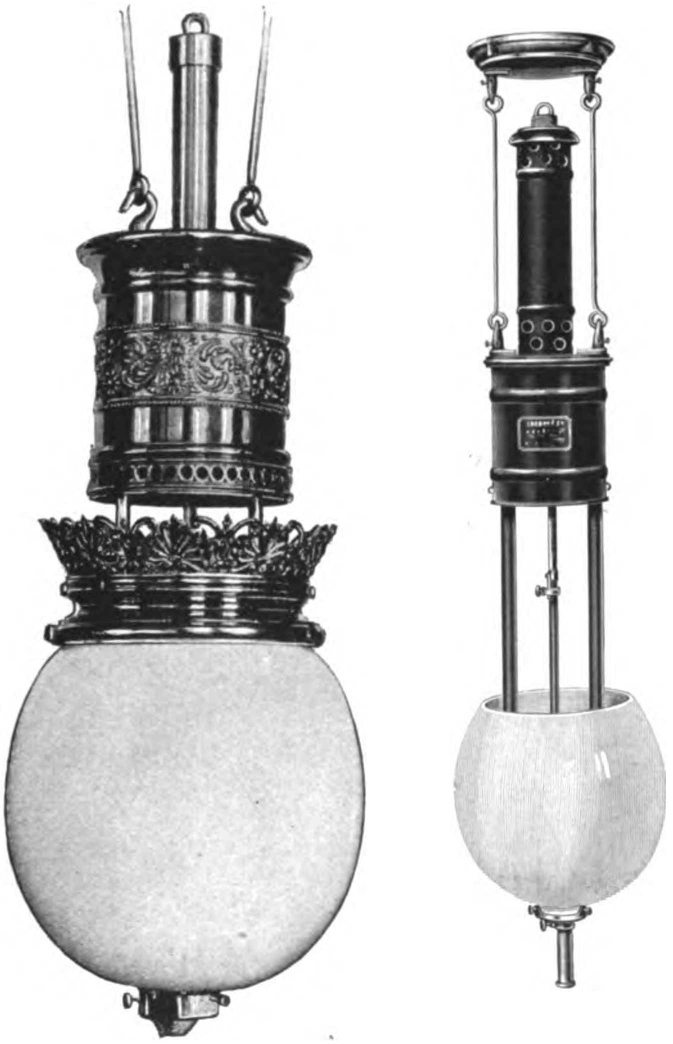
In an article in the current number of the Engineering Magazine Mr. John W. Howells traces the history of the incandescent lamp from Volta's discoveries to the present time. In conclusion he says: "The multiple-arc system of distribution is the ideal one for operating incandescent lamps. It was by making his lamp of such high resistance and such small radiating surface that it could be used on such a system that Edison made his lamp a commercial success. But if we consider the lamp without any reference to any system of distribution, a very high-resistance lamp is inferior to one of lower resistance. The systems of distribution in general use today use lamps of two general voltages—115 and 55. The 115-volt lamps are of very high resistance. The 55-voltage lamps are of lower resistance, and are superior to the 115-voltage lamps. When this fact is more fully appreciated, lower-voltage lamps will be more generally used. By using lower-voltage lamps we can get the benefit of the advantages of the increased stability which these lamps have, and this will enable us to use lamps of fewer watts per candle than are required by higher-voltage lamps. The greater development of the lamp since 1880 has been in its efficiency. The first lamps commercially installed by the Edison company required 6 watts per candle to operate them, whereas now well regulated stations use lamps requiring only 3 watts per candle; thus each horse power produces twice as much light now as it could have produced in 1880. Progress is still being made in this direction. Every improvement in the quality of a lamp allows it to be operated at a higher efficiency, and it is in this direction that we look for future improvements."

Among the telephone companies doing business is the Harrison International Telephone Co., of which Stephen B. Elkins is president, Patrick Egan, secretary and Mr. H. J. Hanford, general manager and assistant secretary. Among the directors are Geo. R. Peck, of Chicago, Robert P. Porter, of New York, R. C. Kerens, St. Louis, and many other equally well known business men.

The New Thomson Arc Lamp for Incandescent and Railway Circuits.

In the accompanying cuts are shown different styles of the new Thomson arc lamp which has lately been brought out to meet the demand for arc lights on railway and incandescent circuits. This lamp is known as the Thomson '93 lamp and contains many points of excellence both in design and construction, adapting it to the needs of constant potential circuits. The lamp is durably constructed and is made in designs to meet either the rough service in the power house or to light the decorated interior of hotel or approach to the club.

There are very few parts in its make up and it contains no delicate mechanism to get out of order. All parts are practically interchangeable. The motion of the carbon rod up or down is practically free, consequently the movement of the rod in trimming is free and does not wear the other parts of the lamp mechanism. The feeding of the carbon is entirely independent of the weight of the carbon and feeds equally well whether with a whole carbon or only part of one.

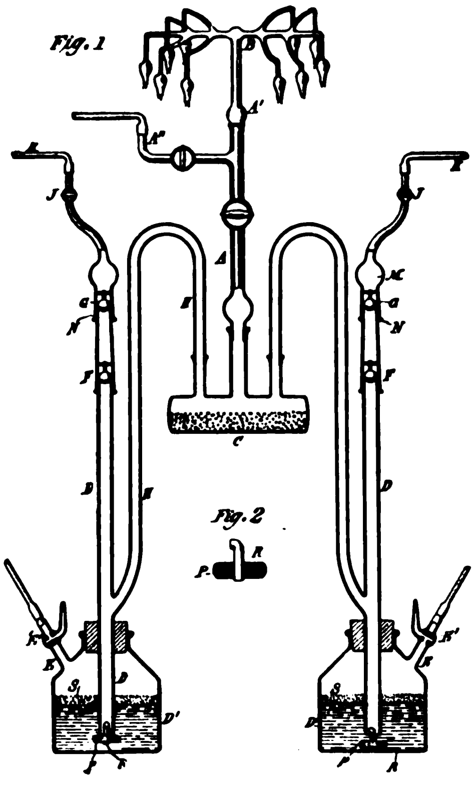


THE NEW THOMSON ARC LAMP FOR INCANDESCENT AND RAILWAY CIRCUITS.

This lamp comes within the geared class. The feed mechanism is a rack rod which carries the upper carbon holder. The rod is of rectangular section, the rack meshes into the teeth of the pinion on an arbor in the case. This arbor also carries a gear which engages with the second pinion on the controlling arbor. Any downward movement of the rack rod and carbon is regulated by a pawl and rachet wheel on the second arbor. The pawl is controlled by the shunt magnet of the lamp and the design is such as to permit but a single tooth only to pass at one movement. The movements can, however, follow each other so rapidly as to allow a practically continuous feed, until the proper length of arc is obtained. The series magnet in the lamp acts to draw and maintain the arc.

The lamps are adjusted for nine amperes and 45 volts, but will be furnished for any current from four amperes up if desired. Four varieties of this lamp have been designed and are now manufactured by the General Electric Company, and one for the alternating current will soon be placed on the market. The long lamp, total length 149 inches, is designed for out door incandescent circuits of 110 volts, it has plain exterior and has extra resistance in chimney.

The short lamp, 32 inches long, is of plain design, for indoor incandescent circuits of 110 volts. Lamps similar, but regulated for the higher potential are manufactured for railway circuits. The ornamental lamp is shorter than the other lamps and the globe is supported from the top on the side of the rods. A focusing lamp, which is but 23 inches in height, is manufactured, designed for indoor use. The arc maintains the same position in the globe owing to the movement of the carbon rods.



AN IMPROVED MERCURIAL VACUUM PUMP.

An Improved Mercurial Vacuum Pump.

The manufacture of the new apparatus used in electrical installations call for new machines and tools. The ingenuity displayed in this direction has facilitated and consequently cheapened the manufacture of electrical appliances. In the accompanying cut is shown diagramatically an improved type of mercurial vacuum pump used in the manufacture of incandescent lamps. Although the well known Geissler principle is used, the pump differs from the usual form and the principle employed is designated as tubular.

The great advantages claimed for this pump are the shortening of the process; the decrease in cost due to the smalle amount of labor and power required, and of a much smaller plant saving the interest and maintainance of a large amount of invested capital. One pump using 45 pounds of mercury will exhaust to the highest degree 10 lamps in 30 minutes as compared with three hours by the usual Geissler process. For the purpose of comparison the following table shows equipment and power required to exhaust 1,000 lamps in 10 hours by the two processes.

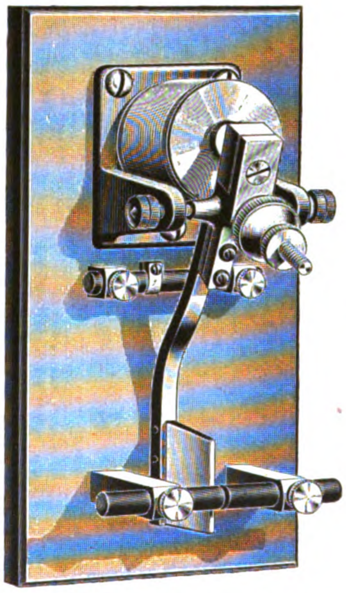
	New Tubular.	Usual Geissler.
No. of pumps..........	7	34
H. P. of boiler and engine	7	34
Capacity of dynamo.....	70	350
Floor space......	12 by 5=60 sq. ft.	35 by 10=350 sq. ft.

This table shows a ratio of five to one in favor of the tubular pump, which gives also a remarkable saving in the original investment. The pump department has hitherto occupied more space than any other department and has used at least 80 per cent. of the power generated.

This pump was patented by Messrs. R. P. Ashwell and J. A. Vandegrift, who have been long connected with the manufacture of incandescent lamps.

The Doane Lightning Arrester.

In the accompanying cut is shown the Doane lightning arrester which differs materially from existing forms of arresters. The effect of a lightning discharge in the ordinary form is to cause a short circuit of the line through the ground by means of the arc which is formed between the points on the arrester. In the form here illustrated the short circuit is made through a non-inductive resistance, sufficient to limit the current that will follow the lightning discharge to an amount that cannot do any injury. With a non-inductive resistance of 100 ohms in series with the arc only five amperes can follow the discharge. This can do no harm and the arc formed is easily extinguished. No current passes through any movable part of the arrester and with only a limited current through the carbons they are practically indestructible.



THE DOANE LIGHTNING ARRESTER.

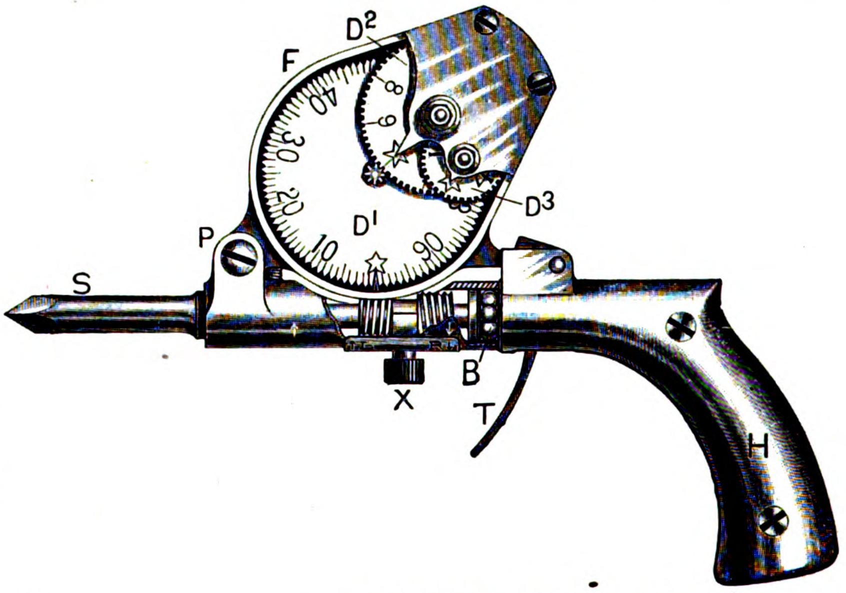
The few parts and durable construction of this lightning arrester will commend it to the trade. There is nothing that can get out of order without being immediately noticed. The many arresters of complicated construction have often failed because they easily got out of order and remained so. The Doane lightning arrester is manufactured by the W. S. Hill Electric Co. of 133 Oliver St., Boston, Mass., which is a well known manufacturer of central station supplies.

The Paragon Speed Indicator.

An instrument designed for the use of engineers and power users is shown in the accompanying cut. It possesses a number of new and important features which improve its use and accuracy. The Paragon speed indicator has been placed on the market by its manufacturers, Messrs. Lintner & Sporborg, of Gloversville, N. Y., to meet the demand for an easily operated and accurate indicator. The accompanying cut shows the general appearance of the instrument, and also something of its construction.

The pistol grip handle gives a firm and convenient hold to the hand. The angular point of the spindle with the ball bearing at the other end insures the revolution of the indicator spindle without loss from friction. The frame in which the dial wheels are mounted is pivoted at P, so that it can be moved downward against the force of a spring to cause the dial wheel to engage with one of the worm gears on the spindle. The wheel faces indicate respectively units and tens, hundreds and thousands of revolutions. By means of the thumb nut at the back of the dial frame the dials are quickly reset.

A shifter slide, moved to the right or left by the thumbscrew, has two worms, one right and the other left, and according to the direction of the revolution of the shaft the right or left worm is thrown into gear. The trigger like lever throws the dials into gear or out as the case may be. An accurate registration may be obtained without looking at the dial. The information desired is thus easily secured.



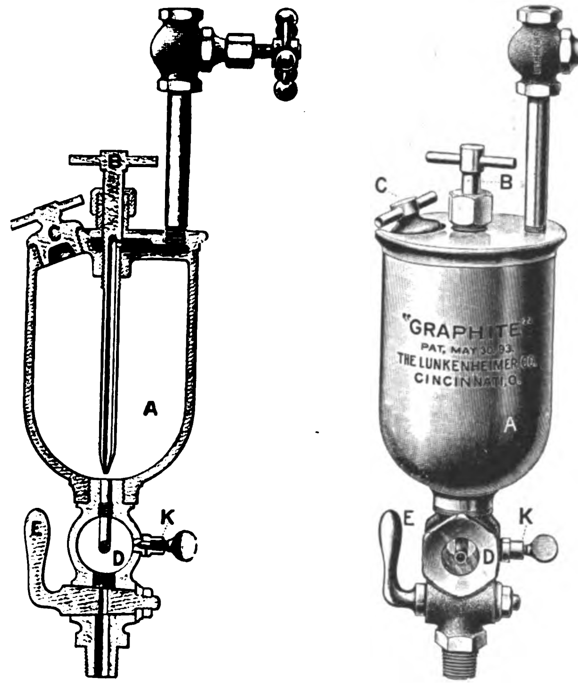
THE PARAGON SPEED INDICATOR.

The Mount Mansfield Electric Railway is to be built this spring running from Waterbury to Stowe, Vt., a distance of 10 miles. The construction and equipment of the road is estimated at $150,000. A waterpower is to be utilized for generating the electricity. The road will carry both passengers and freight. A number of prominent business men are back of the company and it is expected that the road will be pushed to completion. Mr. E. D. Blackwell, who is treasurer of the Vermont Electric Company, has been elected president of the company.

Graphite Sight Feed Lubricator.

In its use as a lubricant as well as for many other purposes, graphite has advanced rapidly in favor. Pure flake graphite being a dry power, has been with difficulty applied to engine cylinders, steam pumps, etc., for which it is said to be unsurpassed as a lubricant. In the accompanying cut is shown an interior and exterior view of a graphite lubricator manufactured by the Lunkenheimer Company of Cincinnati, O.

It not only feeds the graphite continuously in the desired quantities but does it visibly by passing through a sight feed. The cup is attached like any ordinary sight feed oil lubricator to the steam pipe above the throttle, but can be attached below the throttle or on the steam chest with the upper steam connection above the throttle. The interior view shows the interior construction of the lubricator. In operating it the steam valve and stop cock should be closed, the plug C taken out and the cup filled. After the plug is replaced and the globe valve opened, the stop cock E should be so regulated that the desired flow of graphite is visible through the sight feed chamber. The cups are made in capacities from three to eight ounces. Reference to the character of these lubricators is unnecessary as our readers are undoubtedly familiar with the steam specialties of the Lunkenheimer Company.



GRAPHITE SIGHT FEED LUBRICATOR.

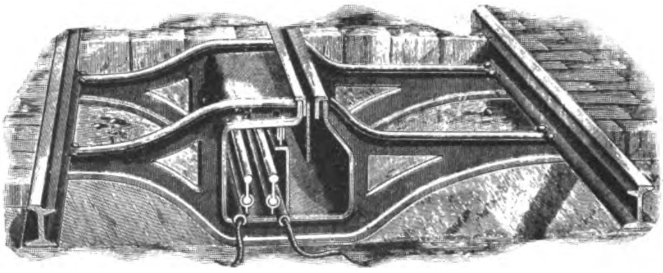
The Petersen Electric Railway System.

There has recently been exhibited in several of the large cities of this country a new underground conduit railway system, which differs materially from those heretofore placed before the public. This system is the invention of Mr. H. Petersen, of the Petersen Electrical Works, Milwaukee, Wis. A glance at the accompanying cut will show the general design of the conduit.

The principal object of the Petersen system is to provide an underground conduit of such construction as to effectually guard against the admission of moisture to that portion of the conduit occupied by the conductors or wires, and to prevent the condensation of moisture on the walls or the conductors or the insulated supports for the conductors. The Petersen system also provides for the ready removal of any dirt which may find its way through the slot by which the conduit communicates with the surface of the ground. Another object of the invention is to provide means for maintaining a circulation of dry cold air within the part of the conduit in which the conductors are located, in order to keep the conductors dry as well as to provide means for regulating the operation of the ventilating apparatus.

Referring to the cut, it will be seen that the entire casing or conduit is located entirely beneath the surface of the ground, and is divided into two or more longitudinal passages or compartments. The casing of the conduit may be made of any desired or convenient form and may be made either from a single casting or from a number of sections fitting closely together at their abutting edges so as to form water tight joints.

In every case, a longitudinal slot is provided in the top of the casing, for the admission of the contact carrying device, which slot communicates directly with one compartment or passage of the conduit, which is arranged at intervals with leads to the sewer, so that any accumulation of dirt, or water which comes through the slot may readily pass off through these connections. The compartment or compartments in which the conductors are located communicate with the compartment in which the slot is formed by means of longitudinal openings which are ordinarily kept closed by a closing device which is engaged by the contact carrying arm as the car advances and opens just sufficiently to permit the passage of the arm and closes immediately after the arm has passed.



THE PETERSEN ELECTRIC RAILWAY SYSTEM.

A steel broom or brush is attached to the car and arranged to extend down into the compartment which has the slot in its top, and sweeps any dirt that enters this compartment to the sewer connections in which the dirt is deposited. In this manner the compartment provided with the slot will be continually emptied of any accumulations of dirt or water and kept clean. For wet climate, this compartment is preferably constructed deeper than the other part of the casing.

The slot rail is extended down at the side of the slot next to the compartment containing the conductors far enough to carry any water which enters the slot down past the opening into the compartment where the conductors are located, and thus prevent water from entering said compartment.

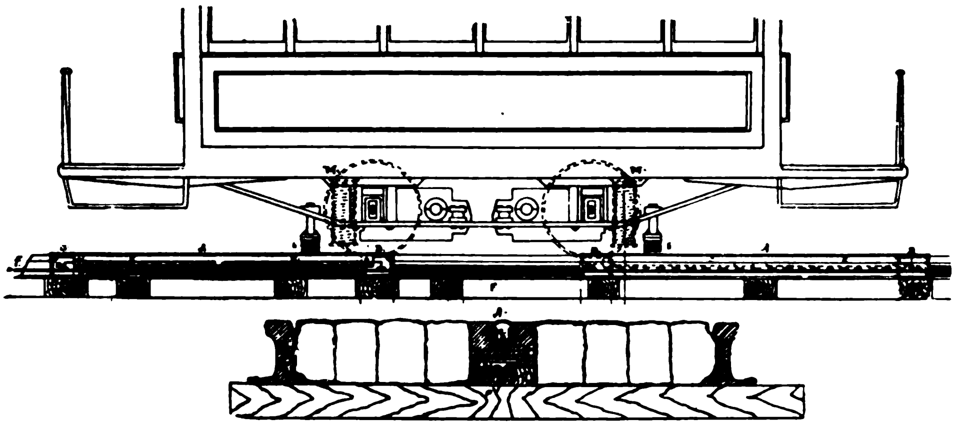
Instead of using trolley wires, this system employs iron or steel contact rails, as shown in the cut. These rails are divided into sections of about 100 feet in length, or of any other desired distance. Each section of the contact rails, is connected with the two main feeders and provided with a switch and a safety cut-out device placed in the manhole, so that in case any trouble should occur, the particular section of the contact rails where the trouble is located can be switched off without interfering with traffic on the rest of the line. By means of the safety cut-out, in case of an accidental short-circuit, the fuse will burn out and thus cut out the section where the trouble occurs. As the iron or steel contact rails are of considerable size in cross-section, and are divided into short lengths or sections, they will be sufficiently good conductors for the purpose.

The Brown Electric Railway System.

Among the more recent electric railway systems brought to the attention of the public is that invented by Mr. E. H. Brown and now the property of the Magnetic Electric Co. of 28 State St. Boston, Mass. The system is operated by an underground conductor without the defects of an open conduit. Thus the system while possessing the advantages of the underground conduit system has neither the disadvantages of the street encumbering overhead construction, nor those of the former.

The accompanying cut shows an elevation of the truck and a cross section of the track. A A represents a brass tube laid in sections about 10 feet long within which are two steel rods about one-fourth inch in diameter connected by a flexible connection to a steel wire cable. This cable passes through the sealed ends of the brass tube to the main line conductor, which furnishes current to the line. The tubes have a core of wood or other insulating material insulating the rods from the brass tube. Beneath the car and near the axles are magnets, M M, which upon passing over a section of tube raise the steel rods against the inner surface of the tube. The brushes, E E, furnish a connection between the tubes and motors.

As soon as the magnets pass from above a section the rods fall back and the tube is again insulated from the feeder. The track is perfectly harmless after the car has passed. The cross section of the track shows the tube and conduit in the center. It is placed entirely above the ties and takes but little room. The first cost of construction is reduced to a minimum.



THE BROWN ELECTRIC RAILWAY SYSTEM

In order to show the practical operation of the system the company has in operation a half mile circular track at Salem, Mass., where any one interested may inspect the system. The equipment is complete in every respect and illustrates a section of road as constructed for practical use. The company is managed by an experienced set of men who are well posted in electrical railway matters. The electrician and engineers of the company have devoted a considerable time to the development of the individual parts and the system is now believed, and as shown by the trial line is complete and worthy of the attention of railway men.

Thomson Recording Wattmeter For Arc Circuits.

There has recently been placed on the market by the General Electric Co. a recording wattmeter for arc lights. In halls, stores, factories, etc., where a group of arc lights is used a demand has arisen for a meter which would record the watts used and this meter has been brought out for that purpose. Similar in construction to the Thomson recording wattmeter it has been designed on the line of an arc lamp so far as its location, etc., are concerned, that is to say, to be suspended from the ceiling by two brass rods fastened to a simple ceiling board, and the same object is attained as in the suspension of arc lamps from the ceiling —the meter is inaccessible except to those who understand its manipulation. A special feature of the meter is the safety cut-out contained within the cover proper. It is designed to close immediately on possible trouble occurring within the meter which might result in the burning out or breaking of the circuit. The cut-out serves to short circuit the meter and cut it out, rendering trouble in the meter impossible. At the same time it preserves the continuity of the circuit and permits the lights to burn without interruption—an advantage sufficiently obvious.

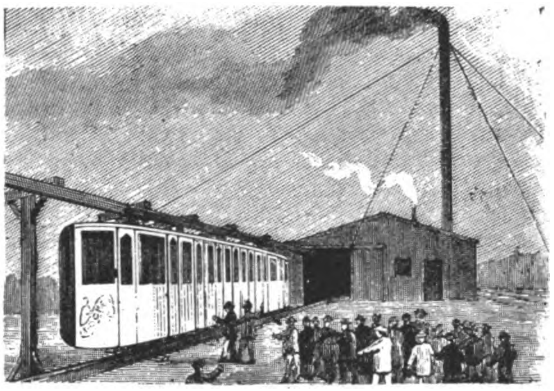
THOMSON RECORDING WATTMETER FOR ARC CIRCUITS.

The connections of the meter are exceedingly simple. The connection blocks are at the top, the wires being brought first to the ceiling board, then dropping to the meter. The two terminals farthest from the front of the meter are connected to the line through an absolute cut-out the two front terminals being connected to the lamps in the house. No trouble will be caused if the linemen should make a mistake and connect the wires which should go through the front terminals to the back and vice versa; there will be no short circuit or burning out. The meter will run backwards but register correctly, subtracting instead of adding to the sum on the dial.

The meter is shipped fully assembled and ready for installation. Careful tests show that the same accuracy can be expected on a minimum load as on a maximum.

The Boynton Bicycle Railway.

At the little station of Hagerman on the Long Island R. R. there has been constructed one and one-half miles of railway which is entirely different from any road previously constructed. The road was constructed under the patents of Mr. E. Moody Boynton who is the inventor of this system of rapid transit. The equipment is complete so far as is necessary to test the operation except as to speed since on so short a line it would be impossible to run a train at 100 or more miles an hour, as this system is capable of according to its promoters.



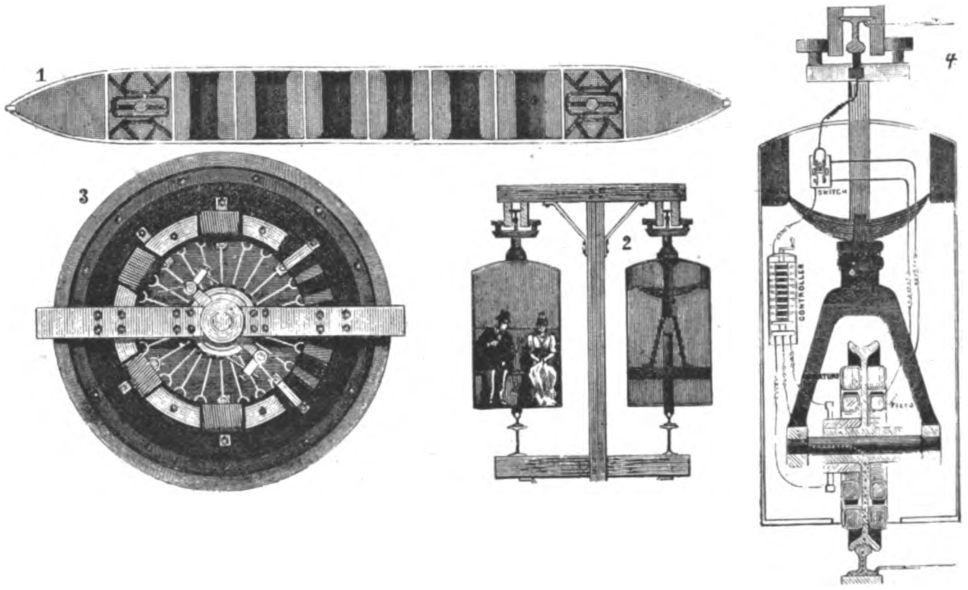
THE BOYNTON BICYCLE RAILWAY.

A row of wooden posts are placed 16 feet apart, the lower end being firmly braced and sunk in the ground. On the upper ends of the posts are cross pieces supporting a wooden guide within which is an electric conductor as shown in the cut. The track consists of but one rail on which the bicycle like truck runs. The car is narrow, but four feet wide. The ends are wedged shape to reduce as much as possible the resistance of the atmosphere. The body of the car is supported on heavy springs which prevent the inequalities of the track from jarring the passengers.

The two wheels, five feet in diameter, are grooved and support on their axles the heavy frames which carry the springs and also on their upper end the small wheels which run along the upper guide and hold the car in an upright position. The four small wheels, two on each side of the guide, turn the drive wheel on curves so that it is always parallel to the direction of the rail. Current is taken from the upper conductor by means of a sliding contact which is connected with the controller. The current returns by the lower rail which is connected to the power station. The armature is mounted on the drive wheel and revolves with it. It is said that the car has very little motion and that, being up and down, is not at all unpleasant.

The car is divided into compartments each seating four persons. On curves the guide rails are placed toward the center of curvature so as to incline the car in that direction. The pressure on the guide rails is thus reduced to a very small amount and the danger of derailment to a minimum. One motor car is said to be sufficient to draw four coaches accommodating 200 persons.

The great advantages of this system are the cheapness of construction, the speed secured and economy of operation. The road is to be built to Bellpont and the power station has been constructed at this place with that in view. It now contains a 100-horse power generator and the necessary appliances for operating the line so far completed. The accompanying cuts, reproduced from the Scientific American, show the details of the car, motor, etc. For cities and thickly populated districts a double track elevated road, as shown in Fig. 2, is proposed. A single row of well braced and substantial posts support both tracks. Fig. 4 shows method of supporting the car on drive wheels, also construction of motor and wiring of the car, while Fig. 3 shows a side view of drive wheel and motor.

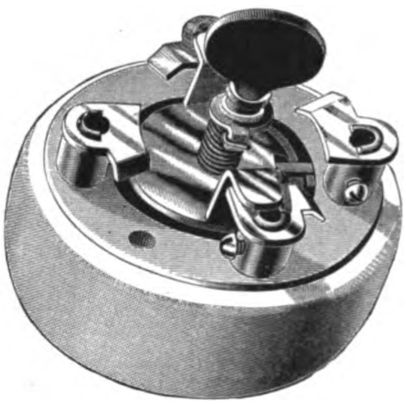


THE BOYNTON BICYCLE RAILWAY.

The draw bridge of the Omaha Bridge & Terminal Company between East Omaha and Council Bluffs is operated entirely by electricity. The electrical equipment includes a storage battery plant of 520 cells, two 40-horse power motors and the necessary switches and regulating devices. The cells are charged from the trolley line of the street railway circuit.

New Three Way Switch.

Illustrated in the accompanying cut is a three way switch recently placed before the trade by the Metropolitan Electric Company of Chicago. It is built on the lines of the "Xntric" switches and is a modification of the 10 ampere single pole switch. The porcelain base contains four contact or binding posts instead of two, as in the single pole switch. Two of these binding posts are joined together by a metal strip on the bottom of the base, making the three points, one double and two single contacts. The contact arm always makes a contact between the double contact posts and one of the single ones. To change the circuit the handle is turned and by the "Xntric" movement the arm flies to the next contacts one of which is one of the connected binding posts, while the other is the other single contact. The base, cap and handle of the five and ten ampere single pole, 10 ampere double pole and the three point switches, are of the same size, which gives a uniform appearance when a number of switches of different capacity are bundled together.



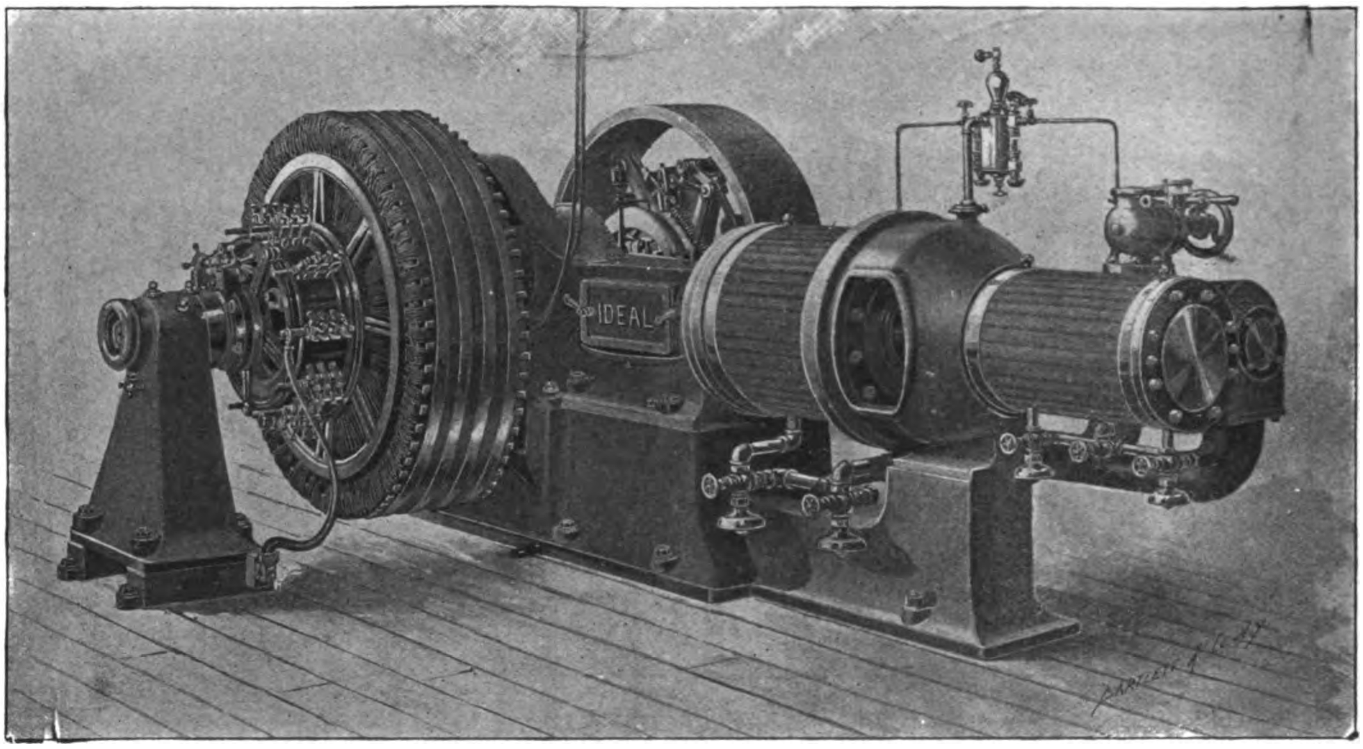
NEW THREE WAY SWITCH.

The electric railway between Baltimore and Washington which was proposed by the Elkins-Widener syndicate some time ago is to be taken up by the Washington Baltimore Electric Railway Co., a company recently organized to build the road. The road by the proposed route will be 39 miles long and will run through Elliot City, Carroll Manor, Clarksburg and Sandy Spring. The road is to be constructed in a substantial manner and the rolling stock after special designs.

Direct Connected Ideal Engine and Dynamo.

The many advantages of the direct connection has lead to their adoption by engineers in the construction of many isolated plants and central stations. The horizontal engine directly connected to dynamo has been used advantageously in many recently constructed plants. The accompanying illustration shows such a combination installed in the Bridgeport Copper Company's works. The dynamo is a multipolar of 80 kilowatts capacity, and the engine is a tandem compound ideal engine with cylinders 10 and 17 inches in diameter and 12 inch stroke.

Under a steam pressure of 125 pounds the speed of the combination is 260 revolutions per minute. The engine, although retaining the main characteristics of the ideal engine, has a number of improved features, one of the most important of which is the self-oiling bearings. The bearings are supplied by a continuous stream of oil, ensuring a perfect lubrication. The boxes are dust-proof, which produces a saving in the consumption of oil and also a preservation of the bearings. The engine is run non-condensing, and as so operated the water consumption is said to be but 23 pounds per horse power.



DIRECT CONNECTED IDEAL ENGINE AND DYNAMO.

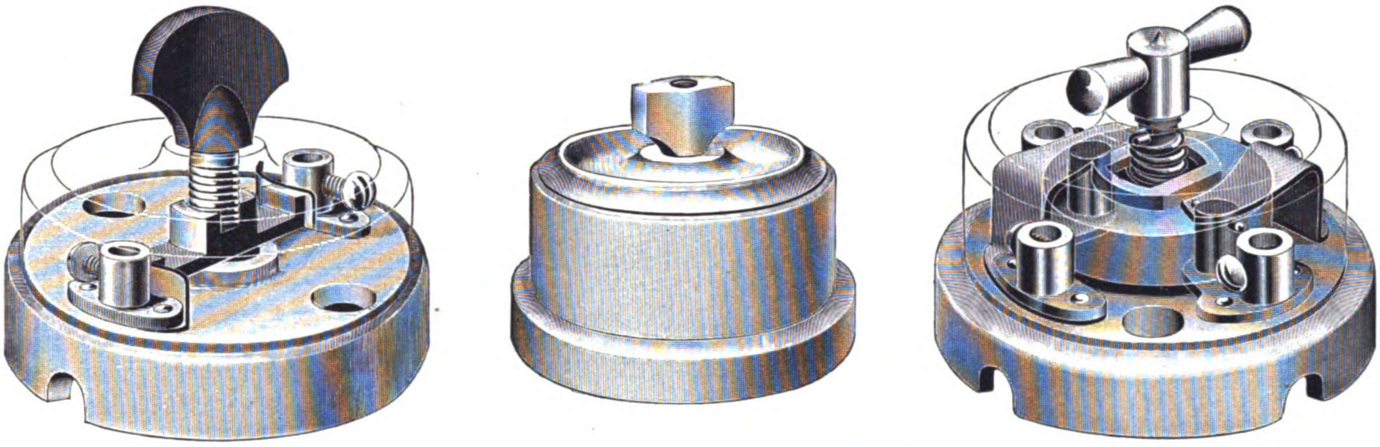
The ideal engine is too well known to need a description, but substantial and well constructed parts are noticeable. The method of supporting the different parts is considered especially good. The engine was manufactured at the Harrisburg Foundry and Machine Works, Harrisburg, Pa. It was installed by the company's representatives for New York and Boston, Messrs. W. R. Fleming & Co., 203 Broadway, New York, and 620 Atlantic Ave., Boston.

The Associated Press has now telegraph wires from ocean to ocean having recently leased wires from Denver, which heretofore has been the western terminus, to Salt Lake, San Francisco, Los Angeles, Tacoma, etc. There are now in the lines operated by the Associated Press over 18,000 miles. The first leased wire of the Association was between New York and Chicago, established in 1885.

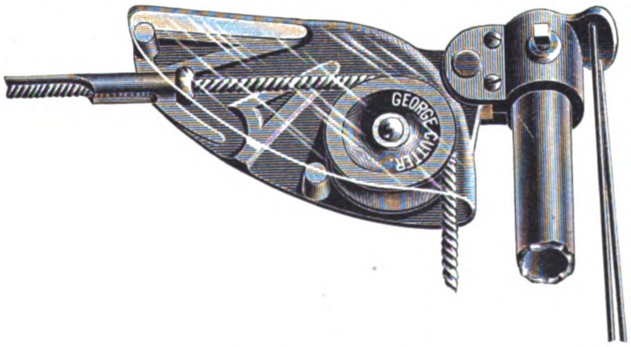
New Perkins Switches.

The switches manufactured by the Perkins Electric Switch Mfg. Co., of Hartford, Conn., have long held a favorite's position among the trade. The simplicity of design has made a durable construction easy. In the accompanying cuts are shown a number of styles of switches. The all-porcelain switches are carefully finished in white porcelain. They have neat outlines and are colored to order in any shade or design required. For residence lighting and decorated interiors these switches are ornamental as well as serviceable.

A single pole switch, which is very durable and is guaranteed to break a 500 volt current, is among the new switches introduced. The base is but two and one quarter inches broad, with contacts at opposite sides, so that with the quick break sparking or short circuits are quite impossible. The switch has a carrying capacity rated at 220 volts of from 10 to 20 amperes. In flush switches a number of styles are manufactured. A flush switch designed for office or residence lighting, with polished or nickel flush plate, making a neat appearance, while it does not project into the room. For places where it is not desirable that the switch should be accessible to every one, a flush switch has been designed on which the flush plate is fastened by a spring lock to the iron casing enclosing the switch. A special key unlocks it. The number of places, public institutions, etc., where these switches are required, has constantly increased since the switch was introduced.


FIGS. 1, 2 AND 3.—NEW PERKINS SWITCHES.

The Gibbs design of switch employs in its operation a principle but little used, its advantages having been almost entirely overlooked. As the handle of the switch, on being turned from left to right, rises by the aid of a screw thread cut upon the same, a nut loose in the insulating block is pressed forward as soon as released from the lock in the case of the switch, with great rapidity, and after a quarter revolution again falls back into the lock, where it is held firmly. These parts revolve only in one direction. The loose contact pins, which allow automatic adjustment between the points, by the use of which a contact is assured by the pressure of the spring copper brushes, is one of the special features of the switch. The line of switches placed before the trade by the company this season is most complete, and is sure to receive the attention it deserves.



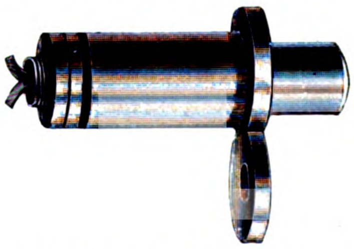
CUTTER'S MAST-ARM PULLEY.

Cutter's Mast-Arm Pulley.

The extensive and continued use throughout the country of the lamp-supporting pulleys devised by George Cutter, has been shown that a simple and reliable safety pulley fills a most decided need. But while this form served the purpose nicely wherever the lamps are hung from suspension wires, there has been a growing demand for a similar device to be used in connection with the mast-arms which are coming into more general favor. The result is shown in the cut, being a modified form of the well-known lamp-supporting pulley and retaining the same simple and automatic action.

This new form has already been given rigid tests in various parts of the country, with most satisfactory results. It has a clamp which not only supports the pulley, but also serves as a head-piece for the end of the arm, so that the bracing can be done from this point. All parts are well made and nicely japanned, the supporting hook-knob being of malleable iron. All told, this new pulley seems to be quite a practical device, and the maker, George Cutter, of Chicago, has good reason to expect a large sale.

An Improved Door Spring.


AN IMPROVED DOOR SPRING.

In the accompanying cut is shown an improved door spring, manufactured by Huebel & Manger, manufacturers of electrical goods at 286 Graham street, Brooklyn, N. Y. It is small in size and can be used on inside blinds and shutters as well as on heavier doors. The entire apparatus is substantially made and perfect contacts are assured. It is effectual in its operation and can be relied upon. The firm has had an experience in the manufacture of almost every kind of electrical device and bring this out to meet the demand for an efficient and durable article. The shape adopted enables it to be quickly attached to the door in such a manner as not to mar its appearance.

ODDS AND ENDS.

The amount of wire in the underground conduits of the city of New York is estimated at 34,000 miles of which 32,600 miles are telephone and telegraph wires and 1,300 miles of electric light wires.

It is reported that Messrs. Johnson and Lundell are reaching for the $50,000 prize offered by the Metropolitan Traction Company having been for some time engaged upon a system of rapid transit. The system is said to be electrical but the scheme is not yet ready for the public.

The following contracts were awarded the first of last month by the lighting commissioners of the city of Detroit for the municipal plant: S. F. Dodge engines, triple expansion, $20,000; Chas. A. Strelinger & Co. boilers $31,500; 18 100-light dynamos Western Electric Co., $41,250; double carbon lamps Brush Electrice Co. $41,969.

A resolution was recently passed by the council of the city of Boston to prohibit the use of the front platform of street cars operated in that city to passengers, that gates be provided for both sides of the platform and that the front door of the car be provided with suitable lock so as to render it impossible for passengers to use the forward platform.

The Cataract General Electric Co. has secured from the state of New York, the right to use the right of way along the canals of the state to lay conduits and run wires for the purpose of transmitting electricity. The company is to furnish in return at each canal lock such an electrical installation as necessary to light, open and close the lock. The company must also furnish current for the propulsion of canal boats at $20 per horse power. The work is to be completed in three years.

At a recent meeting of the Institute of Civil Engineers, London, the cost of operating the Liverpool Overhead Railway for the months of July, August and September was stated as 3.44, 3.70 and 4.07 pence, respectively, per train mile. The increase in cost was due to the increase in price of coal. The contractors under the agreement had to run the trains for 3½ pence per train mile on a full service of 2,400 miles per day, but as the entire length of road was not open they received 4 pence per mile.

The five year contract made by the city of Minneapolis in 1892, for lighting the streets of that city has been declared void by the judges in the recent suit to annul the contract. The judges gave as their opinion that under the city charter the city had not the right to make a five year contract as the council cannot incur debts or liabilities that cannot be paid out of the funds actually levied for and applicable to said payment. The funds of the city are levied to pay the expenses of the next fiscal year only.

So far the propelling of vehicles by storage batteries has not been a financial success. The original cost and the expense of running have been too great to encourage their use. However, there has recently been placed on the streets of London, a parcels van or light delivery wagon driven by electricity. The current is supplied by accumulators suspended beneath the body of the wagon. One charge of the battery will propel the wagon 50 miles at any speed not exceeding 10 miles an hour. The work of changing a discharged battery for a charged one requires but a couple of minutes. The motor takes up but little room and the steering and regulating is easily accomplished. Incandescent lamps for lighting the van are run from the battery. The cost per mile, it is claimed by the promoters, is much less than with horses. A few months' use will show whether this is correct or whether the relative cost is reversed.

A short strike, but one that during its continuance had more disgusting features than many a larger and longer one, occurred on the street railway running from Steinway to Hunter's Point, L. I., the middle of last month. The trouble arose over a reduction of wages necessitated by the present depression of business. The strikers and sympathizers blocked the road by obstructions, smashed the cars, cut the trolley wire and other equally lawless and disgraceful acts. The matter was finally placed before the mayor for arbitration and the men returned to work.

Norway has many important waterfalls of which but a few have so far been developed. A project has been recently placed on foot for utilizing the power of two falls situated at a distance of about 24 miles from the city of Christiania. By a system of electric transmission the power is to be transmitted to the city and there utilized in lighting the streets, operating tramways and power for any purpose desired. The cost of the installations is estimated at about one and one-half million of dollars and it is expected that it will be completed by January 1896.

Among the novel railways which have been in use is one that for three years has been operated across the Tennessee river at Knoxville, Tenn. The length of the road is 1,060 feet and the purpose is to carry passengers across the river to Unaka Park. Two one and three-eighths-inch cables reach from the Knoxville side to the opposite bluff 350 feet above the river. The car, which seats 16 passengers, is suspended from these cables, and is drawn over by two 20-horse power engines in the power house and goes back by gravity. The park is an attractive resort and the aerial railway has paid a fair profit until a recent accident discouraged travel. The endless cable by means of which the car is drawn up the inclined cables broke just before the car reached the upper bank, the automatic brake stopped the car before it had gone back many feet, but the cable unwound and fell below turning the car by its weight up at an angle of 45 degrees. The passengers were rescued with difficulty by being lowered to the river below.

The executive committee of the American Street Railway Association met recently at Atlanta, Georgia, to make arrangements for the annual convention which is to be held on the third Wednesday in October. The building at which the meetings will be held and also the exhibits of street railway machinery and appliances is in the Piedmont Exposition Grounds which is but a short distance from the center of the city. The main building is 520 by 74 feet with a wing 64 by 74 feet in which the auditorium is located. One half of the building is supplied with power and shafting and railroad tracks will deliver goods at the building. The committee has selected the Hotel Aragon as the headquarters of the members during the convention. This hotel has everything that can be desired for the comfort and convenience of its guests, being an entirely modern hotel. Local committees have been appointed to look after the accommodations for the convention. Mr. L. R. Shellenberger is chairman of the committee having the exhibits in charge. Those desiring to make exhibits will do well to correspond with him at the Equitable Building, Atlanta, Ga.

The Wagner Transformers.

The phenomenal growth of the alternating current system for the distribution of light and power during the past six years, and its almost exclusive use by central stations of to-day, has caused a demand for greater perfection in the apparatus employed. While the large manufacturers have shown great energy in the improvement and development of generators, the transformer has, until recently, received but little attention, and the earlier designs and efficiencies have been but slightly changed.

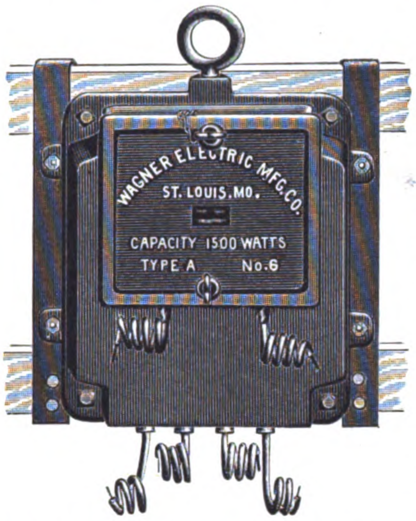
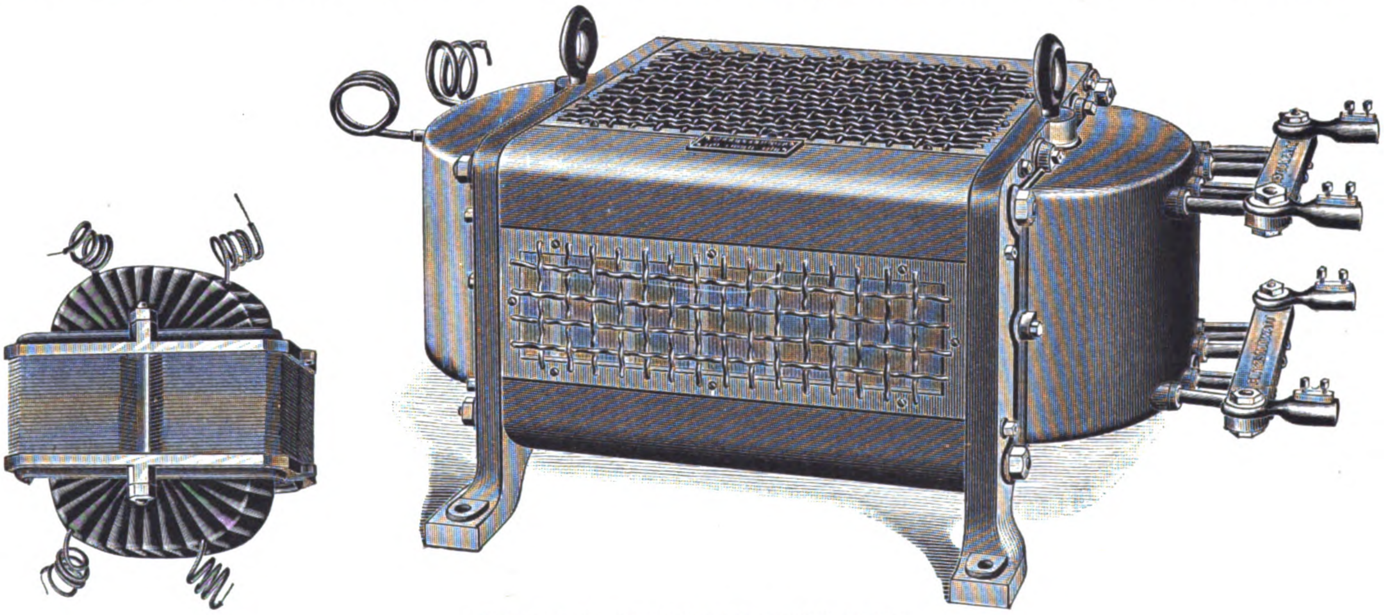

WAGNER ELECTRIC MFG. CO.
ST. LOUIS, MO.
CAPACITY 1500 WATTS
TYPE A No. 6

FIG. 1.—THE WAGNER TRANSFORMER.—
30 LIGHT.

The most vital and important element of this system has thus been comparatively neglected until recently having become the subject of an independent industry, it is beginning to claim the consideration due it. Being capable of the greatest refinement and perfection in efficiency, it is the great determining factor in the profitable operation of every electric plant, and on its durability and insulation depend safety to the consumer and the life of the installation. The first requirement—electrical design—necessitates perfect knowledge of theoretical characteristics on the part of the manufacturer, and the second—insulation, reliable and convenient mechanical design—requires long practical experience in both manufacturing and operating. The Wagner transformer is the result and embodiment of several years' experience in the use of transformers in one of the large stations. Numerous attempts have been made to design transformers which could be repaired with ease, but as a natural consequence efficiency has been, without exception, sacrificed to this end. In all such designs, the removal of the coils is facilitated by making two or more decided breaks in the magnetic circuit, that a portion of the iron core may be removed, thereby rendering a small magnetizing current impossible. It would seem much wiser to so design apparatus that repairs would not be necessary, and this has been the aim. High and practically indestructible insulation, though costly, is obtainable, and such material should be used. Insulation may be destroyed in two ways—by heat from the transformer itself, and by strain from excessively high voltages produced by lightning or inductive discharges on lines supplying a large number of transformers.



FIGS. 2 & 3.—THE WAGNER TRANSFORMER.

It has been the purpose in the construction of these transformers to effectually guard against both these agents, and the experiments have resulted in the use of a special insulation, and a special method of coil winding. To such a degree of perfection has this been carried, that every transformer readily withstands ten times the normal primary voltage, impressed between the primary and secondary coils, and none leave the factory before being tested in this way with 8,000 volts. In step-up transformers without oil insulation, this is carried up to 10,000 volts. There are many who consider nothing equal to oil insulation for transformers, and although its use is considered with this insulation unnecessary, a full line of oil-tight boxes are manufactured. As the result of an exhaustive series of tests an oil of remarkable insulative qualities has been found and an extremely high fire test, rendering it most suitable for transformer use.

As the life of incandescent lamps is greatly dependent on the maintenance of uniform pressure or voltage, it becomes of the utmost importance to avoid in transformers an excessive difference in secondary voltage, between no load and full load. Although the usual practice has been to allow a drop or difference of 2½ per cent, or more, it is believed that this amount should not be exceeded, even in the smallest size transformers, and in large sizes, to be used for secondary distribution over large areas where the loss in the wire is necessarily appreciable, this should be reduced to less than 2 per cent. The limit fixed in these transformers for the various sizes are as follows: 10 lights to 60 lights, 2½ per cent drop, 80, 2¼; 100, 2; 125, 1.8; 250, 1.5 and 500 lights 1.5 per cent drop.

A further refinement in regulation, while readily obtainable is not usually desirable on account of its interdependence with leakage or magnetizing current. This constitutes the principal loss or waste in the transformer, and therefore demands the most careful consideration. In any given transformer it may readily be varied within quite wide limits by allowing the regulation at the same time to vary inversely. Having limited the latter, however, by the requirements of the best practice and safety to lamps, the leakage current has not been reduced to the lowest possible figure compatible with comparatively light weight. This so-called "leakage current" is that which is always flowing through the primary coil, and is practically constant whether lights are burning or not, being the resultant of the real magnetizing current and the current supplying the loss by hysteresis and eddy currents in the iron core. The actual energy or power wasted in this way, however, is not found directly by the product of this current and the primary electro-motive-force, for owing to the difference in phase between these two factors, it is much less than this. The ratio between the apparent energy thus found and the true loss, is called the power or lag factor, and is usually about .7.

On account of hysteresis, this "leakage current" is dependent to a large extent on the quality of the iron employed, and may therefore differ considerably in two transformers in all other respects identical in design. On account of their construction, the Wagner transformers are guaranteed not to vary appreciably from the efficiency advertised. In the smallest sizes of transformers the apparent leakage energy will not exeecd 5 per cent of the total capacity, and in the largest sizes will not be over 1 per cent. The real loss will not be over .7 of this, giving an efficiency of from 95 to 98 per cent according to size as shown in the efficiency curves.

The details of mechanical construction have been carefully considered and special attention has been given to the primary fuse box, which has been a troublesome part of many transformers. The fuse box, while cast in one piece with the transformer case, is entirely separate from the interior. The only connection is the small holes through which the primary wires pass. The fuses are mounted on separate porcelain blocks, which are made in two parts, one being permanently attached to the box and carrying the contacts and the other carrying the fuse. No fuses are used in the secondary connections and by a special arrangement connections may be made for either 50 or 100 volts. In many cases stations using generally 50 volts may find it advisable to use 100 volts when a large number of lamps are to be installed on one secondary, the decreased cost of wiring more than offsetting any loss in other directions.

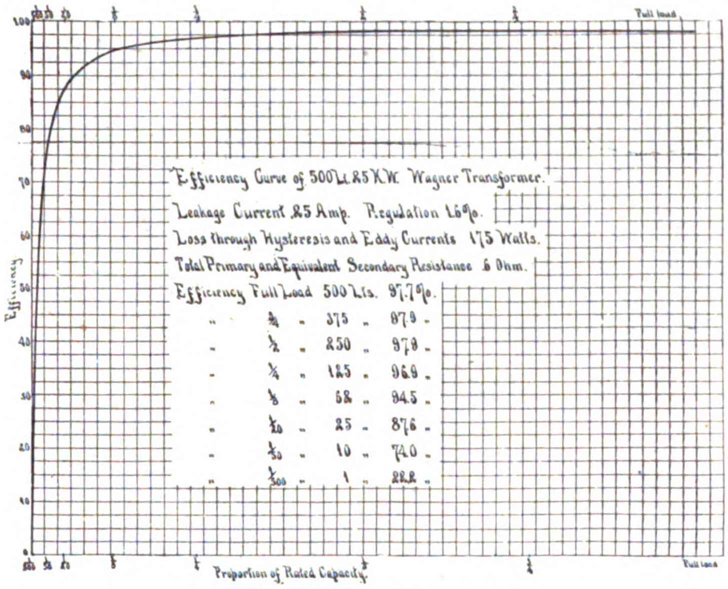


FIG. 4.—THE WAGNER TRANSFORMER.

Transformers of all sizes are provided with eye bolts for convenience in handling, and with four lugs for supporting on cross arms or wall. If preferred wrought iron straps wtth hooks on upper ends, are attached to said lugs, by means of which the transformer may be hung directly from cross arm or cleat. Sizes above 200-light capacity being to heavy for safe suspension are made only for inside use with partly open case, except when oil insulation is used. Sizes over 500 lights capacity are made only for use with oil.

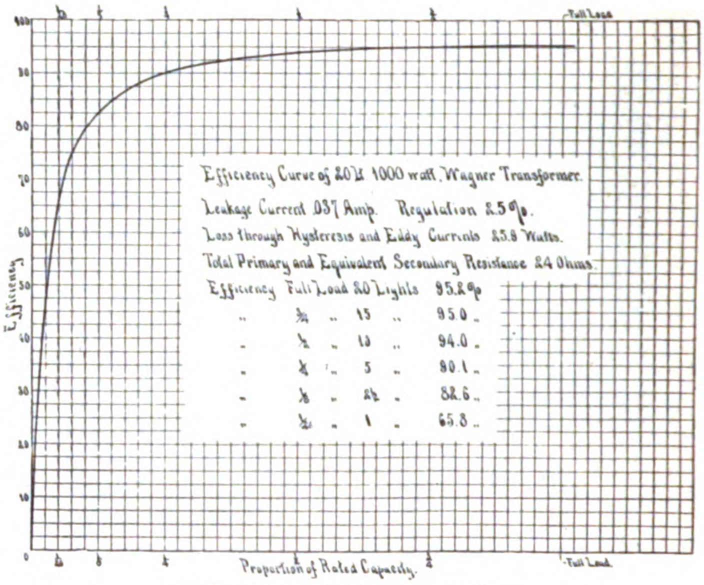


FIG. 5—THE WAGNER TRANSFORMER.

The recent development of arc lighting from alternating current incandescent circuits has created a demand for special transformers for use in connection therewith. Such transformers are manufactured for any number of lights, reducing from 1,000 or 2,000 volts to 30 volts, for primary connection, and from 100 or 50 volts to 30 volts for secondary connection. Transformers for many special uses are also manufactured. These transformers are manufactured by the Wagner Electric Co., of St. Louis, Mo., for whom Mr. Wells Goodhue, Monadnock Blk., Chicago, is the northwestern agent.

The first meeting of the Chicago members of the American Institute of Electric Engineers was held at Armour Institute March 21st, the time of the regular meeting of the Institute in New York. The paper on "The Effects of Heavy Gases in the Chamber of Incandescent Lamps," by Prof. W. A. Anthony, was read at both meetings. Prof. D. C. Jackson read the paper at Chicago. An original paper on "The New Form of Carey-Foster Apparatus" was read by Prof. W. N. Stine, of Armour Institute. Through the courtesy of the Metropolitan Telephone & Telegraph Co., The American Telephone & Telegraph Co. and the Chicago Telephone Co., telephonic communication was established between the two meetings.

In "Notes of a Trip to the United States and to Chicago" read before the Institute of Electrical Engineers (London), W. H. Preece, C. B., F. R. S., said: "The favorite arc dynamo in the States is said to be that supplied by the Standard Electric Light Company. There was a large exhibit, six machines, of this type in the Exhibition. The largest size worked with 6,550 volts, and maintained 120 arcs in series. It is fitted with a very effective and rapid working automatic governor, regulating the range of the brushes so that as lamps were turned off the current was maintained constant and the voltage changed. Six seconds only were needed to regulate the brushes from a load of one lamp to 50 lamps."

Electric Machines of the Walker Mfg. Co.

In the January number of ELECTRICAL INDUSTRIES appeared the announcement that the Walker Manufacturing Company were making preparations to manufacture a complete line of electric railway and power machinery with a description of the excellent facilities possessed by the company for this work. At the works at Cleveland, O., the plans formed by the company have been gradually brought to completion, and in the accompanying cuts are shown in outline some of the machines which are now on the market. The long experience of the company in the manufacture of railway machinery enables it to place before the trade equipments that are fully abreast of the times and in every way adapted for the heavy service of the street railway.

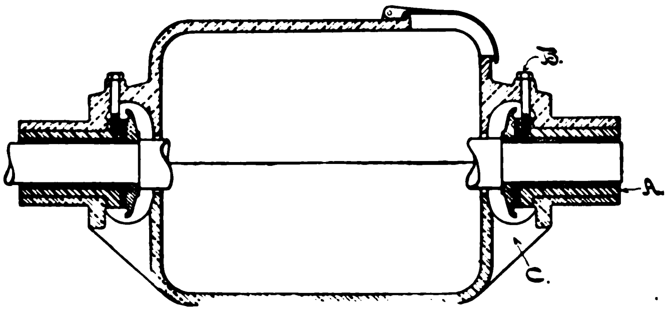


FIG. 1.—ELECTRIC MACHINES OF THE WALKER MFG. CO.

Every thing required in the complete equipment of an electric road and in the electrical equipment of the power house is now being manufactured by this company. Preparations are also completed for the construction of apparatus for the long distance transmission of power, a line in which the company anticipate large developments in the near future, mining apparatus of improved designs and general power generators and motors both continuous and alternating current. Extra large sizes of machines will be a specialty at these works.

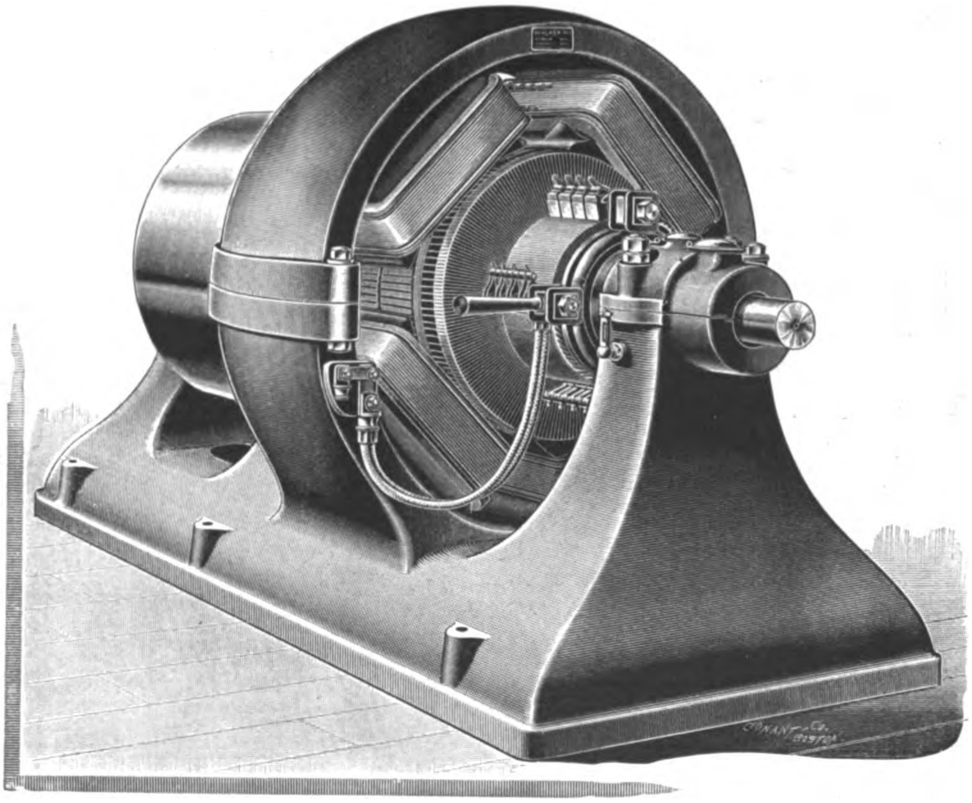


FIG. 2.—ELECTRIC MACHINES OF THE WALKER MFG. CO.

In Fig. 2 is shown a 250-horse power generator for street railway and direct current power transmission. It is of the well known four-pole slow speed type. The rigid and substantial construction of the frame is one of the most noticeable features. The frame is cast in one piece, with three bearings which are of the ball and socket self-oiling type. One half of the yolk is cast with the frame and the other half separate, so that it can be removed to allow the armature to be taken out. The field magnets are of wrought-iron and carry heavy coils.

The armature is series and is insulated entirely with mica. With two path-windings, the only kind used by the company, there can be no unbalanced armatures and no sparking. The windings are entirely below the surface of the armature, which is iron-clad, with no binding wires. The only joints in the wires are where they are connected to the commutator segments. The commutator is large and should run cool. It is the intention to construct the larger generators of this type on the engine shaft and the smaller ones as belted machines.

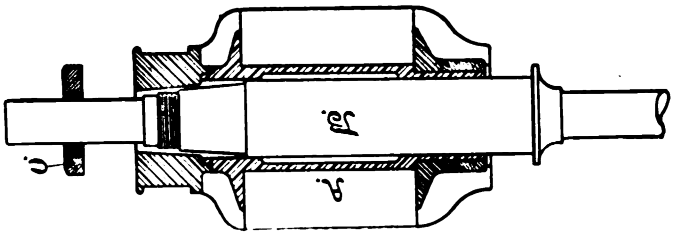


FIG. 3.—ELECTRIC MACHINES OF THE WALKER MFG. CO.

In Fig. 6 is shown the street railway motor mounted on truck. In suspending the motor the method employed has been worked out after a careful study of the causes of the wear of track and rail joints and also of the motor and car equipment. It is well known that not only the hammer blow due to the weight of the motor, but also the inertia blow due to the unyielding mass of the motor are the most important causes. In order to correct this evil it was determined to make the motor as light as possible without decreasing its efficiency or its ability to stand severe service and also to suspend the motor so that iron to iron contact is avoided and prevent not only the hammer blow, but also the inertia blow. The motor placed on the market by the company weighs 1,200 pounds, has a capacity of 25-horse power and will run up to 25 miles an hour. The plan of suspension is shown in the accompanying cut. It is attached to the axle only through yielding supports.

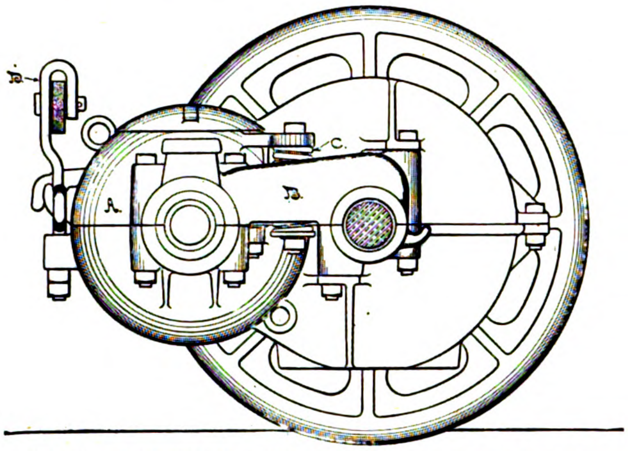


FIG. 4.—ELECTRIC MACHINES OF THE WALKER MFG. CO.

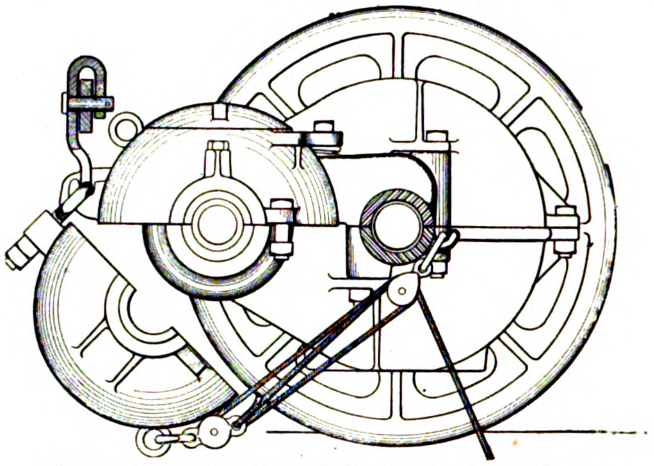


FIG. 5.—ELECTRIC MACHINES OF THE WALKER MFG. CO.

The motor is shown mounted on 30-inch wheels. It is of the four pole type and perfectly dust and mud proof. The only opening is through the lid by which the brushes are gotten at. The frame is of two parts and made of steel. The gear housings and commutator lid are of malleable iron. Both gears and pinions are of steel. The shaft is three and one half inches in diameter and two and one half in the bearings. The bearings are long and arranged for perfect lubrication. The detail cuts show the cross section and end view of motor the wheel being taken away to show the method of mounting. In Fig. 4 *B* is a cast iron "*U*" shaped frame, the rounded end being journaled on the car axle. Swinging freely between the arms is the motor trunioned by its bearings, but not touching the axle. The motor is then supported at the rear by spiral springs *c*, between lugs on the frame and the arms of the "*U*," and at the front end is supported by a swinging arm from the ordinary spring truck bar D. It can thus be seen that the motor rides freely and adjusts itself to varying conditions.

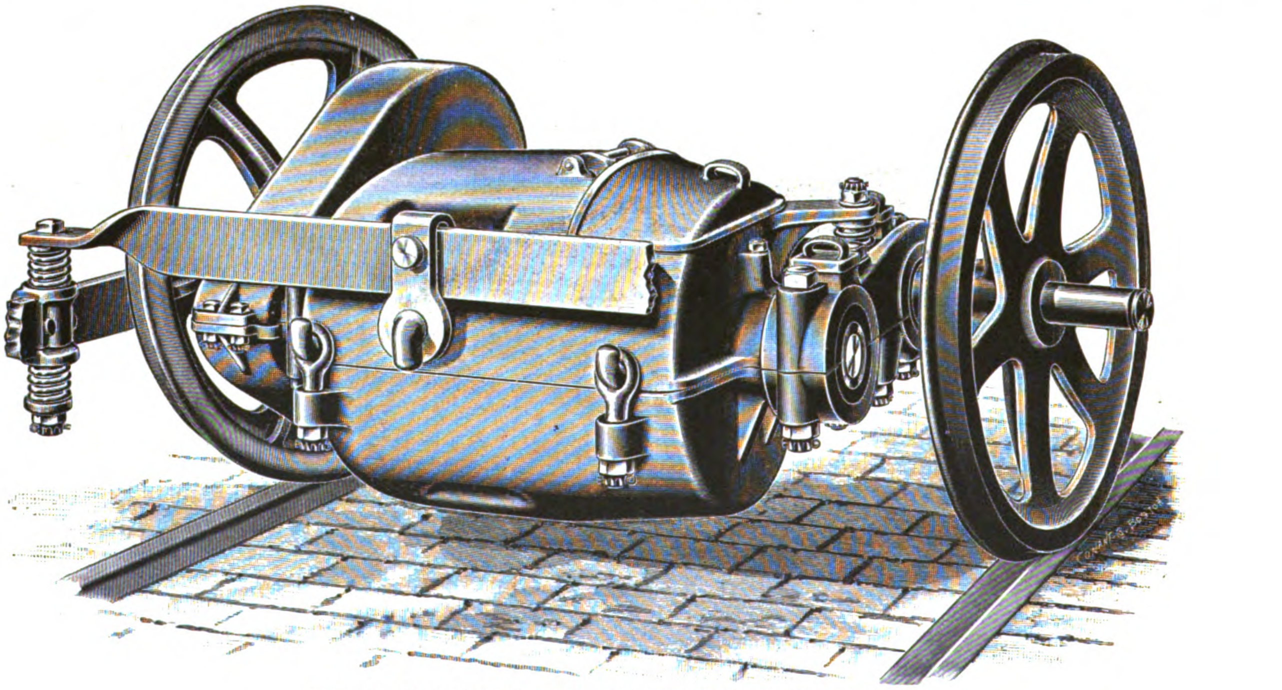


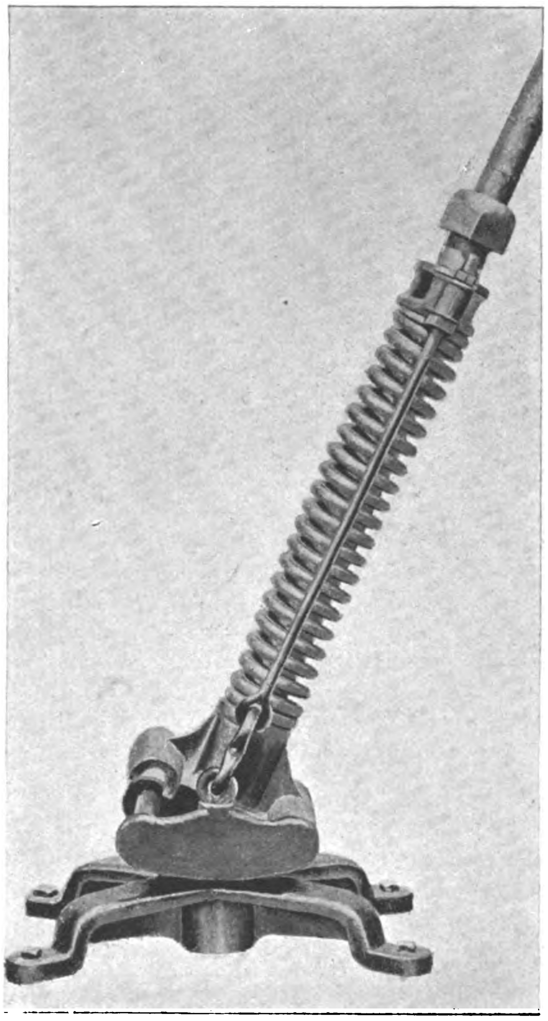
FIG. 6.—ELECTRIC MACHINES OF THE WALKER MFG. CO.

In Fig. 5 the method of swinging down the lower half of the motor is shown. One man can easily lower it and raise it by this means. If desired the armature may be removed from below, or if a pit is not at hand, from above. The bearings are outside of the motor casing, they are solid shells filled with babbitt and are supported by a bolt. Whatever grease comes out between the end of the thrust collar and inner end of the bearing falls to the ground through a sufficiently large opening so that will not clog up. The core of the armature is built on a separate sleeve which receives the shaft. The shaft can therefore be taken out and another put in without destroying or injuring the armature. The commutator and pinion are held in place by nuts locked by an ingeniously devised washer. The motor runs quietly and smoothly; the gears run in oil in air tight housings. A series parallel controller is used for controlling the motor.

Heavier motors are also made where large cars or several trailers are drawn. The 35-horse power weighing 2,500 pounds is built on the same general lines as the smaller motor. It will operate on 30-inch wheels with plenty of clearance. Motors for elevated suburban or interurban trains have also been designed. Special attention has been given to those for high speeds. In the manufacture of stationary motors numerous styles and types are being constructed.

The Gibbs Trolley Standard.

In the trolley standard shown in the accompanying cut the simplicity of the design and strength of each part is at once apparent. The arm bends quickly to the different distances of the trolley wire and holds the trolley wheel firmly against the wire. It is quickly attached to the car. All parts are made interchangeable. The different street railway companies using them have forwarded the makers many testimonials of their durable character.



THE GIBBS TROLLEY STANDARD.

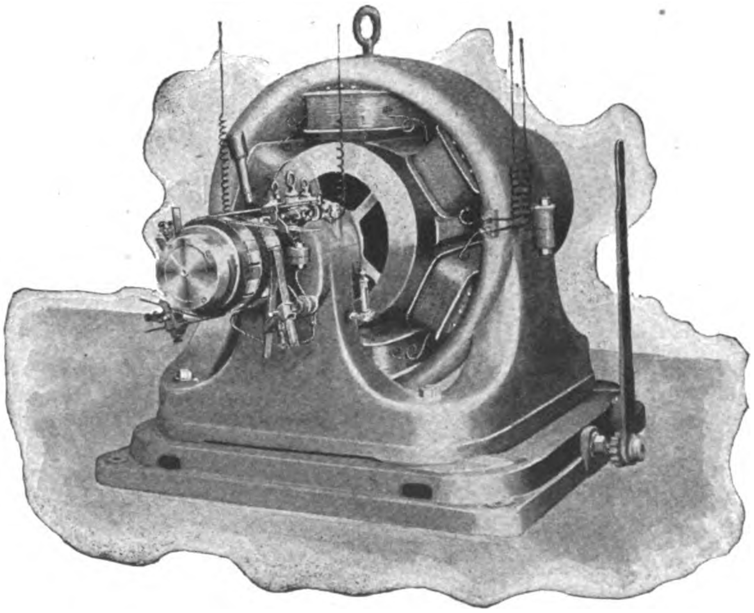
The Metropolitan Electric Co., Chicago, has placed it among the railway supplies handled, and is now carrying everything in that line required by the trade.

Hood & Osborn, Chicago, report a good business in the line of electric lighting apparatus of the LaRoche make, for which they are the general western agents. The 1,300 light alternator which they recently installed for the Hammond Electric Light & Power Company of Hammond, Ind., is running in good shape and giving entire satisfaction. Through a slight error the compositor made the notice referred to read 13 light instead of 1,300. This firm report the outlook for business as improving, especially in central station equipment and for power plants. The success which has attended the sale of electrical apparatus during the past few months has been more than could be expected during what is considered one of the dullest seasons in many years.

Westinghouse Direct Current Arc Generator.

The arc dynamo illustrated in the accompanying cut differs widely in general appearance from the types which have for many years been on the market. In general outline it is similar to the generators for which the Westinghouse company is well known. This dynamo is placed on the market after a long period of experimenting on the part of the engineers of the company in the endeavor to obtain a machine which would fill all the requirements of direct current arc lighting. The results of these extended and elaborate experiments have been embodied in this machine.

It belongs to the open coil continuous current class of machines, which is generally acceded to possess special advantages for arc lighting work. The armature coils in these dynamos do not form a continuous winding closed upon itself, but consists of a small number of coils so connected to the segments of a commutator that during a portion of every revolution each coil is cut out of circuit, while during the remainder of the revolution the coil passes successively through different combinations with the others. The machide delivers a uni-directional though not a continuous current, for while the electro motive force of the terminals does not change its sign it nevertheless pulsates or fluctuates. This pulsating of the electro motive force gives a steady mean value to the current and makes it particularly adapted for arc lighting as its pulsating character keeps the mechanism in a slight but constant vibration, thereby rendering them less liable to become slow in action or altogether fail to feed.



WESTINGHOUSE DIRECT CURRENT ARC GENERATOR.

The armature is of the tooth type with lathe wound coils heavily insulated. It is supported in self-oiling bearings with spherical seat. The construction of the dynamo has been carefully looked after and the same workmanship is apparent as in the well known types of Westinghouse machines. The regulation of the dynamos is effected by the reactive effect between the winding of the field and the armatures. It is absolutely self regulating. The commutator is of special construction and the best results are secured by separating the commutator strips by a half inch of insulation. No vicious sparking takes place and four sets of brushes collect the current without the use of blowouts.

The efficiency of these machines is said to be above 90 per cent, an efficiency which is much above that formerly obtained in the best machines. A decided departure has been made by the company in the price of these machines with the accompanying apparatus, such as exciter, meters, lamps, etc.

Nicholson Flange Face Compression Coupling.

The coupling illustrated in the accompanying cut has been designed to meet the requirements of the better grade of couplings. In appearance it resembles the ordinary flanged face coupling, but has a number of improved features. The two half castings are bored tapering, and have flanges on rim to cover nuts and bolt heads. The outer faces of hub are closed almost to shaft by a rib or projection through which slots are cut to place the keys or jaws in position while coupling is being fixed on shaft.

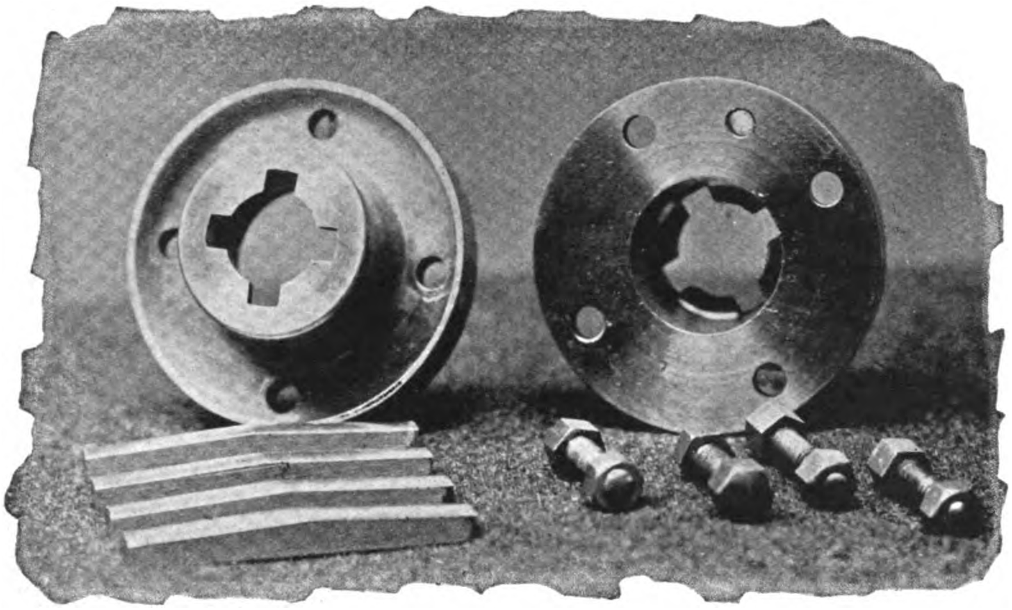


FIG. 1.—NICHOLSON FLANG FACE COMPRESSION COUPLING.

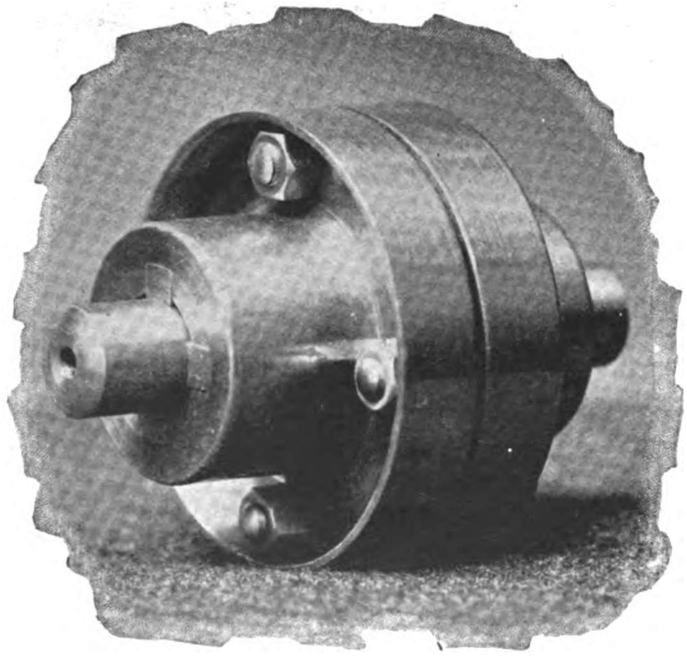


FIG. 2.—NICHOLSON FLANG FACE COMPRESSION C UPLING.

The steel jaws have double taper, turned to fit bores of casting and are concaved on their inner faces a trifle less than the radius of the shaft, which makes the grip positive when drawn up by the bolts. The couplings are constructed to allow a space of from three-eighths to three-fourths of an inch between flanges, enabling a larger or smaller size of shaft than gauge size to be coupled.

Broken shafts may be quickly repaired by one of these couplings. The time and expense of key seating is not required nor is it necessary to reface couplings after being keyed to shaft.

The shaft is held in perfect alignment. The grip is equal on four sides, and is quickly attached or detached. It is guaranteed to hold under the heaviest strain. The coupling is manufactured in various sizes by the Link Belt Machinery Co., of Chicago, and the Link Belt Engineering Co., of New York and Philadelphia.

The Allen Soldering Stick.

In all electrical construction a very important part of the work is making joints or electrical connections in the wire. Nearly every large electrical contractor has undoubtedly learned that a properly made joint is as essential to a perfect installation as the use of high grade material or first class workmanship. Manufacturers of high grade wires have frequently had their insulation severely criticised, and even condemned, on account of the failure of some particular job to properly test up, when the difficulty has not been with the wire but with the failure to make proper joints. Many a station manager has been perplexed in measuring up the resistance of his lines and the loss of energy thereby, to know why so many miles of line of such a size should show a resistance so far in advance of what it ought to be in accordance with the tables and other data at hand, when if the truth could be known it would be very likely discovered that quite a liberal part of the coal pile each month is being required to overcome the resistance of defective joints all along the line.

Its application is so much more simple and convenient that a lineman can afford to give a little more care and attention to each joint and at the same time accomplish more work than he could under the old method.

The compound is put up in the form of a round stick six inches long and one inch in diameter and has about the consistency of sealing wax when cold. When rubbed on a heated joint it melts and covers the joint producing a bright surface to which the solder adheres with great readiness. The Electric Appliance Co., the manufacturers, believe it will become a favorite with wiremen.

CORRESPONDENCE.

LETTERS FROM PRACTICAL MEN.

[In reply to a letter asking method of lighting streets by incandescent lamps from railway circuit.]

Editor Electrical Industries: Your letter of the 19th received. I run a No. 6, well insulated wire from my feed wire to switch, then through the parts of the town to be lighted as far as the last lamp, then ground to water pipe or any other good ground, putting 10 lamps in series (of 52 volt equals 520 volts; from all railway circuits there are 500 volts; the 20 extra volts save lamps, allow for variation in current); then I start off to another part of the town and put in another circuit of 10 lights. The people are very much pleased with the lights. I hang them over the middle of the street where the trees are thick, suspended upon two wires so I can pull them in if a new lamp is needed. Our system is Westinghouse. We have power enough so the lights do not vary for outdoor lighting. It has been a success and pays well. Many a town along the line of an electric road could be lighted in this way. Thirty-two c. p. lamps give a nice light. This was a project of my own and I feel proud of it. Very likely there are others who are doing the same thing but I never have seen any of it in this way. Yours truly,

(Signed) Everett K. Day, Supt.

Sanford, Me., March 22d.

Editor Electrical Industries: I have read the communication published in your columns with interest, and although I have encountered many difficult problems from time to time, they pass from memory and are only recalled by subsequent problems. It is not the great problems that puzzle the engineers so much as the little things for which he cannot discover a cause. I remember an interesting experienced published in a paper some time ago which will illustrates this. An engineer found that in one of his engines there was a constant thump, thump, every time the piston moved. A thorough examination of every part of the cylinder and valves failed to find anything wrong and because he could find nothing, the matter worried him the more and he studied nights as well as days on it. At last while studying over the different parts of the cylinder as he had them laid out before him, he found that when the two parts of the double cylinder head were together there was an air space of but a fraction of an inch and the idea occurred to him whether the heavy metal was flexible enough to give that much and strike the other piece. He fixed it so the two plates could not come together, and put the engine together, started it and to that day when he forwarded his communication he had had no trouble. I shall watch your column and when next I have anything of interest I will place it before you and my fellow workmen for their consideration. Yours truly, S. D.

Editor Electrical Industries: What kind of a device do you recommend for feeding boilers—an inspirator or a steam pump? H. L., New Orleans, La.

An inspirator or an injector of suitable size to maintain a steady feed is most economical in the use of steam, because nearly all of the heat is returned to the boiler; while a steam pump requires a large amount of steam to do the work and the greater portion of the heat is lost. A steam pump is usually most convenient as it can be used for other purposes and an injector or inspirator cannot, except with considerable loss of steam. If you have more than one boiler, an injector, inspirator, or feed pump should be connected so that steam may be taken from either boiler. In the case of injector or inspirator the steam should be taken directly from the dome or boiler shell and not from a pipe supplying steam to any other device, as this current of steam will impair, to a certain extent, the working of an injector or inspirator.

Editor Electrical Industries: We have an 80-H. P., high speed engine that is shaking the foundation loose. The parties who put in the engine claim it is perfectly in balance and that the foundation was substantially built; but in spite of their assertion the foundation will soon tumble unless repaired. We have no spare power and cannot see our way clear to lay off the engine long enough to fix the foundation. It is not dangerous yet, but will be if something is not done before a great while. Will you kindly give us some suggestions as to a practical way of overcoming the difficulty? W. L. P., Chicago, Ill.

You will probably find one cause of the trouble in the valve motion of the engine, the load being unequal at either end of the cylinder. If the foundation was built of good material and carefully handled it should still be in good condition. If this is the case a careful adjustment of the valves should prevent any further trouble. You can fix the foundation by placing a box around it and filling with quick setting cement, made thin enough so it will penetrate the cracks. This should be done just after shutting down so that the foundation may stand as long as possible after the cement is applied before it is used again. If proper adjustment of the valves does not stop the shaking of the engine, then some part is considerably out of balance and it will be necessary to lay off the engine until the proper repairs can be made.

Editor Electrical Industries: I am a motorman and want to get as much information on the subject of electric generators and motors as I can, so I will take advantage of your offer to provide answers to correspondents in the columns of your paper, every issue of which I read attentively. There is a peculiarity about the commutator of one of the motors on a car which I have been running. The insulation in the commutator appears to be very hard, so that the copper wears away faster than the insulation and this leaves little ridges that make the brushes jump and cause considerable sparking. Can you tell me if the fault is with the insulation between the commutator strips, or is the trouble due to something else? H. P., Cleveland, O.

The trouble is probably due to some peculiarity in the winding of the armature as it has been found that when the terminals of the armature coils are laid side by side without extra insulation, it causes the insulation in the commutator to wear faster than the copper portion, while if the terminals are wound separately and then brought side by side and attached to the segment, the copper will wear fastest, leavthe mica insulation exposed. A remedy for either of these defects is to connect the terminals at the armature, bringing the conductor to the commutator. The defect just explained does not take place to such an extent on generators as on motors.

Editor Electrical Industries: Would inquire of your dynamo expert if in his judgment it is desirable to clean our incandescent dynamo commutator with benzine; if so how often, when run about six hours a day? Also if desirable to put our brushes in benzine and how often, or, in other words, if this should be done whenever they show that vaseline has begun to accumulate between the ends of the leaves and also if gasoline well answer the same purpose as benzine? Would also inquire how often, or under what conditions, should our commutator be dressed down with a block and fine sand paper? Thanking you in advance and trusting we may have an opportunity to reciprocate, we are, Yours truly,

(Signed) G. B. E. Lt. Co.

GREAT BEND, KAN., March 17.

In running a dynamo the commutator should be cleaned with a flannel cloth once a day and should be kept covered when not running so that the dust will not accumulate on it. Such care will preserve it. But a small amount of vaseline should be used. A little applied on a small cloth is sufficient. Would not use benzine on commutator as many insulations are destroyed by it. Your brushes if cleaned and trimmed will not need anything. From various causes your commutator may become rough, some of the bars may be a little higher than others, or the shape of the commutator may have become elliptical instead of round. These defects you can detect by moving your finger along the commutator while running, or by watching the brushes you will see them vibrate, fly up, or simply move up and down. If you notice none of these irregularities you may infer that your commutator is all right. If the commutator is not too badly out of order it may be brought into good condition by the use of fine sand paper on a block. If this is not sufficient it should be turned down in a lathe. After using sand paper care should be taken to clean the commutator of the sand. Emery should not be used.

One of the machines in our station is a 500 light T. and H. alternator. One evening when testing, the ground detector lamp burned. Next day I tried the magneto and there was no signs of a ground on the line. I next tried the commutator segments and rings; no ground on the circuit. I next tried the frame of the machine and found it was grounded by moisture under the floor. I thought possibly there was an iron contact between armature and frame, but the insulation was good. When I would turn on the detector I could notice a smell of shellac and thought at first the ground detector was new, and possibly it was, but there was no heat in it. I went over to the machine and found the smell came from the armature of the dynamo and by repeatedly testing it found my surmise correct. What was the matter and what caused the smell of shellac in the armature? I had no trouble after the ground was removed. ISAAC ENNES.

With this statement of the case it would be difficult to tell positively why the ground detector showed a ground and why the smell of shellac was present, but suggest the most probable solution. Moisture in the armature coils would cause them to heat, which would account for the smell of shellac. A little dampness might also make a short circuit from the armature to the frame and the frame to earth. In using the dynamo the coils would dry out and the cause of the difficulty disappear.

A careful reading of the report of the Washington convention published in the March number of ELECTRICAL INDUSTRIES will be found a benefit to all connected in any way with central stations. The subjects discussed were timely and the experiences of the central station men brought forth in the discussion were of interest and will be valuable in future work.

AMONG THE CENTRAL STATIONS.

WAUKESHA, WIS.—Geo. G. Ramsdell is now vice-president of the Waukesha Electric Light Company.

LAMPASAS, TEX.—J. T. and W. L. Donovan have bought the Lampasas electric light plant and will run it by water power.

LANDER, WYOMING.—H. E. Wadsworth is now secretary and purchasing agent of the Lauder Electric Light and Power Company.

INDIANA, PA.—G. W. Gilbert is now secretary of the Indiana Electric Company. Its capital stock has been increased to $40,000.

EAGLE PASS, TEX.—M. L. Oppenheimer is now vice-president of the Electric Light and Power Company, and S. P. Simpson treasurer.

FRESNO, CAL.—L. Leach has been elected president of the Fresno Gas and Electric Light Company; L. Einstein, vice president, and A. Gutsch, secretary.

OIL CITY, PA.—B. F. Brundred, who was formerly secretary of the Oil City Electric Company, is now president, and Geo. R. Harley is now secretary and treasurer.

SHARPESVILLE, PA.—At the recent election S. Perkins was elected president of the Sharpesville Electric Light Company, and F. H. Foster superintendent and engineer.

BRIDGEPORT, ALA.—Geo. N. Messiter is now secretary and treasurer of the Electric and Ice Company.

TUSCALOOSA, ALA.—Geo. A. Searcy is president and A. R. Smith secretary and treasurer of the Gas, Electric Light and Power Company.

TUSCUMBIA, ALA.—J. T. Kirk is the new president of the Water and Electric Light Company.

TEXARKANA, ARK.—B. T. Estes is now president and P. Bauer, manager and purchasing agent of the Gas and Electric Light Company.

OAKLAND, CAL.—Jno. W. Coleman is now vice-president of the Gas, Light and Heat Company.

PLACERVILLE, CAL.—Linley Cowper was recently elected secretary and treasurer of the Electric Light Company, which has leased its plant to J. Green & Son.

SULLIVAN, ILL.—P. L. Reid is now secretary, treasurer and purchasing agent of the Electric Light & Power Company.

WINCHESTER, IND.—By a recent change in the officials of the Winchester Electric Light Company J. W. Thompson becomes president and O. L. Moorman secretary, treasurer and purchasing agent.

LEAVENWORTH, KAS.—By a change of officials Frank O'Donnell becomes president and R. Springer secretary of the Merchant's Electric Light Company.

MCPHERSON, KAS. — J. F. McElvain is now secretary and treasurer of the Western Water & Electric Company.

MINNEAPOLIS, MINN.—Edw. B. Martin was recently elected president of the Minneapolis Water Company and Jas. Ketner secretary and purchasing agent.

QUINCY, ILL.—Fred. Wilms is now president and F. A. Parker purchasing agent of the Thomson-Houston Electric Light & Power Company.

CROWN POINT, IND.—By a recent change in the management of the Crown Point Electric Lighting & Power Company E. S. Tice is the present managing owner.

GREENFIELD, IND.—Richard A. Black is the newly elected president of the Electric Light & Power Company.

MISSOURI VALLEY, IA.—By recent change in this company Jas. S. Dewell becomes president, C. H. Deur secretary, and A. Edgecomb manager.

NEVADA, IA.—W. F. Swayze is now president and U. S. Kinsey manager of the Nevada Electric Company.

OLATHE, KAS.—B. C. Morrison has recently purchased the Olathe Electric Light Plant.

TOPEKA, KAS.—J. Mulvane has recently been elected president and J. V. Hathaway manager and purchasing agent.

FLINT, MICH.—The People's Electric Light Company at the annual meeting elected the following officers: F. P. Smith, president; A. H. Gillies, vice-president; A. G. Bishop, secretary, and R. Putnam, treasurer.

Georgetown, Colo.—F. P. Dewey has been elected treasurer and L. D. Timmons, manager and purchasing agent of the United Light and Power Company.

Avon, Ill.—Geo. A. Tompkins is secretary and treasurer and H. F. Townsend, purchasing agent of the Milling and Manufacturing Company.

Bement, Ill.—W. J. Day has been elected secretary and manager of the Electric Light and Power Company.

Carbondale, Ill.—Geo. W. Graham is now treasurer of the Electric Company.

Centralia, Ill.—The Electric Light & Power Company has sold its plant to the Centralia Light & Power Company.

Decatur, Ill.—J. H. Culver has been appointed purchasing agent, and E. T. Coleman secretary and treasurer of the municipal plant.

Elgin, Ill.—H. E. Shedd is manager and purchasing agent of the city plant.

Freeport, Ill.—L. Z. Farwell, owner of the new Gas, Light & Coke Works, has appointed T. F. Renner general manager and G. H. Currie superintendent and electrician.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Phœnix, Ariz.—The Farmers' Manufacturing & Trading Company will add an arc dynamo and ten motors.

Burlington, Vt. — The Vermont Electric Company will install power generators the coming spring.

Boston, Mass.—The Suburban Light & Power Company contemplates adding a new switchboard. E. R. Fish is purchasing agent.

Lexington, Mass.—The Lexington Gas Light Company will add an incandescent dynamo and a 150-horse power boiler. R. B. Taber is purchasing agent.

Allegan, Mich.—The Allegan Electric Light & Power Company may add a new alternator soon. L. H. Harrison is purchasing agent.

Detroit, Mich.—The Edison Illuminating Co. will increase its capacity in all departments. S. C. Mumford is purchasing agent.

Monroe, Mich.—The Monroe Electric Light & Power Company will add a 350-horse power engine. G. R. Hurd is purchasing agent.

Fostoria, O.—A company is about to be formed for the purpose of installing and operating an incandescent lighting plant. Address G. W. Bercaw, Electrician.

Milwaukee, Wis.—The Milwaukee Arc Light Company contemplates several improvements the coming season. G. Wenninger is purchasing agent.

Marseilles, Ill.—The Marseilles Electric Light & Power Company is in the market for a complete plant. Mr. Ferd. Schumaker, of Akron, O., is interested. Guy C. Gunn, is purchasing agent.

Gt. Barrington, Mass.—The Great Barrington Electric Light Company contemplates the installation of an alternating system, also water works. W. Lewis is purchasing agent.

Bay City, Mich.—The city will install a new engine in its lighting plant, and also add largely to its lamp equipment. Wm. H. Fitzhugh is purchasing agent.

Prairie du Chien, Wis.—The Prairie City Electric Company has just completed its plant and will make extensions in response to the demand. J. I. Keller is purchasing agent.

Pittsburgh, Pa.—The Hazlewood Electric Company, which was recently organized, is receiving proposals for a complete plant of about 50 arc and 3,000 incandescent lights. T. M. Jenkins is purchasing agent.

Holland, Mich.—The City Electric Light Plant commenced operations in February last, although it is, as yet, not fully completed. John Kramer is purchasing agent.

Philadelphia, Pa.—The Southern Cotton Oil Co., will rewire its eight mills. Robert Hollingsworth, 16 S. Third St., is purchasing agent.

New Hampton, Ia.—The New Hampton Electric Light & Power Company contemplates the installation of 30 32-candle power lamps for street lighting. It desires to sell bonds for the purpose of extending its lines. L. L. Briggs is purchasing agent.

Athens, Ga.—The Athens Manufacturing Company will install a plant of 300-horse power this summer.

Tariffville, Conn.—The Frank Wilkinson Manufacturing Company will soon install an incandescent plant of some 200 lights.

New Haven, Conn.—The New Haven Rolling Milling Company will install a 10-light arc plant for a new mill. F. E. Williams is purchasing agent.

New Haven, Conn.—The Bigelow Company will add a new arc light machine. George S. Barnum, treasurer, is purchasing agent.

Kennett Square, Pa.—The Kennett Electric Light, Heat and Power Company will double its power plant. R. Z. Dallas is purchasing agent.

Lynn, Mass.—The Lynn Gas & Electric Company has recently completed its new station.

Bellefontaine, O.—The Bellefontaine Light & Power Company has been organized. C. B. Horner is secretary.

Mamasoneck, N. Y.—The Larchmont Electric Company's plant is approaching completion. It is to furnish lights for streets for a period of ten years from June 1st, 1894.

Milton, Mass.—The Milton Light and Power Company will increase the capacity of its plant. Murray Ruggles is purchasing agent.

Korbel, Cal.—The Humboldt Lumber Mill Company will install a 300 light incandescent plant to be run by water power. Address F. Korbel & Bros. 723 Bryant St., San Francisco, Cal.

Maderia, Cal.—The Maderia Electric Company may add an arc circuit, as well as extend its incandescent lines.

Lancaster, Pa.—The Citizens' Electric Light, Heat & Power Company which has very recently commenced operation, states that it has one of the most modern and complete plants ever built.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

Westchester, Pa.—The Suburban Railway Company which was recently incorporated has elected officers as follows: Wm. Jenks Fell, president, M. M. Child, secretary and Wm. S. Kirk, treasurer.

Ocean City, N. J.—The Ocean City Electric Railroad Company contemplates the extension of its lines to cover the entire length of the beach, which is seven miles. E. B. Lake is purchasing agent.

Hoosick Falls, N. Y.—The Hoosick Railway Company has yet about three miles of track to construct. It is expected that it will be equipped and completed by June next. C. B. Story is secretary.

Hazleton, Pa.—The Lehigh Traction Company has seven miles of track under construction and it will be ready to operate early in July next. E. S. Doud is secretary.

Alton, Ill.—The Alton Electric Street Railway Company will construct 10 miles of street railway which will be electrically equipped. New engines and boilers will also be installed.

St. Louis, Mo.—The Clayton & Forest Park Railway Company reports its track completed but not yet wired. B. F. Thomas, 220 N. Fourth St. is secretary.

Tamaqua, Pa.—The Tamaqua & Lansford Street Railway Company, recently organized, reports its officers as follows: F. P. Spiese, president; D. D. Phillips, vice-president; A. P. Blakeslee, secretary and P. J. Ferguson, treasurer.

Middletown, N. Y.—The Middletown-Goshen Traction Company hopes to have three miles of road ready for operation by April 15th. When completed it will be 14 miles in length.

Galt, Ontario.—The Galt & Preston Street Railway Company (Limited), is now building its road, and hopes to have it completed by May 24th next. Its length will be five miles; $40,000 of 20 years, 5 per cent bonds are for sale. W. H. Lutz, is secretary and treasurer.

Jacksonville, Fla.—Right of way has been obtained for a railway seven miles long that will require little grading it is said, and will have a large freight traffic, besides a large passenger traffic in winter. The line projected will make a connecting link between the St. John's river and a trunk line. B. L. Aldrich can give particulars.

FINANCIAL.

The past month with a period of fine weather has witnessed a more general resumption of business. Low prices and lower wages are the universal rule. A cut of as much as 30 per cent from one year ago is not an uncommon thing in the more extensive works reopened. The low prices is the one cause of complaint. This, however, has in a measure stimulated the building trades for many are taking advantage of the low prices of material and labor to erect houses and buildings for future requirements. This, in connection with the overhauling incident to the preparation for the summer's business has created a demand for electrical goods. A number of large contracts for electric railway and power house equipments were reported during the month. The supply trade is also reported as good.

The prices of bonds and other securities have made a slight advance, showing a greater confidence on the part of investors. Westinghouse stock has made the greatest advance during the month. The confidence in the management of the company, the important contracts recently secured and the condition of the affairs of the company have each aided in the advance. The small number of shares in the market prevent any manipulation on the part of speculators. The quarterly dividend on the preferred stock of 1¾ per cent is payable April 2, that amount having been voted at a regular meeting of the board of directors.

The annual meeting of the General Electric Co., to be held at Schenectady, Tuesday, April 10, is looked forward to with interest. The advance in price of stock in February is maintained in anticipation of the showing that will be made of the affairs of the company at this meeting.

At the annual meeting of the Commercial Cable Co., held in New York, March 5, the usual quarterly dividend of 1¾ per cent was declared. The statement of the affairs of the company showed the gross earnings for 1893 to be $1,842,346, with expenses, $784,600, leaving a net income of $1,057,746 or $41,840 less than the year of 1892; $600,000 of debenture bonds have been paid off and $400,000 more provided for. At the annual meeting of the stockholders of the Bell Telephone Co. the old board of directors was re-elected. For the year ending December 31, 1893, the treasurer's report gave the net earnings as $3,926,485, an increase over the previous year of $563,810. The expenses were $1,855,500 and dividends have been paid amounting for the year to $3,339,156. The assets of the company are placed at $45,712,340.

Name of Company.	Description of Security.	Amount Issued.	Par Value.	Rate Int.	Date Payable.	Clos-ing Mar. 27.
Miscellaneous Securities.						
American Bell Telephone Co.	Stock.	$17,500,000	100	....	J. Q.	184
“ “ “	Bds. 1893.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co.	Com.	14,000,000	100	....	....	85
Commercial Cable Co	Com.	7,716,000	100	....	....	120
Edison Elec. Ill. Co., Boston	Com.	2,025,800	100	....	F. Q.	110
“ “ “	C.Bds. 1898.	71,000	100	6	M. & S.	.....
“ “ “	C.Bds. 1901.	586,500	100	6	M. & N.	.....
“ “ Brooklyn	Com.	2,500,000	100	....	Q. F.	85
“ “ “	1st. 1940. Regis.	500,000	100	5	A. & O.	100
“ “ “		....	100	5	A. & O.	.....
“ “ Chicago	Com.	3,000,000	....	8	Q. F.	145
“ “ “		2,500,000	....	....	....	.....
“ “ New York	Com.	7,938,000	100	....	Q. F.	97
“ “ “	1st 1910.	2,562,000	100	5	M. & S.	104½
“ “ Phila	Com.	1,473,000	100	....	....	120½
“ “ “		....	....	5	....	.....
Fort Wayne Elec. Co	Com.	4,000,000	25	....	....	3½
General Electric Company	Com.	30,457,000	100	....	....	42¼
“ “	Prf'd.	4,251,900	100	....	....	65
“ “	Deb. 1922.	10,000,000	100	5	J.-D.	70
Gold & Stock Tel. Co	Com.	5,000,000	100	....	Q. J.	....
Northwestern Gen. Elec. Co	Com.	1,000,000	100	....	....	.....
“ “ “	Prf'd.	750,000	100	....	J. Q.	.....
Thomson Elec. Welding Co	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	....	....	.....
Thomson-Houston Elec. Co	Series D.	120,000	10	....	....	5⅜
Thomson-Houston Intern. Elec. Co.	Com.	600,000	100	....	....	.....
“ “ “ “	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co	Com.	1,000,000	100	....	....	.....
“ “ “	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co	Com.	94,820,000	100	....	Q. J.	85
“ “	Var. Issues	13,088,000	100	7&5	M. & N.	108
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	32
“ “ “	1st Pf.Cum.	3,755,700	50	7	....	46
Electric Railway Securities.						
Brooklyn—						
Brooklyn City R. R	Com.	6,000,000	10	....	Q.-J.	170
“ “	1st Bds.1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R	Com.	500,000	100	....	Oct. 1.	.....
“ “ “	1st Bds.1909	300,000	100	5	J. & J.	....
“ “ “	Certf. 1894.	300,000	100	6	J. & J.	....
Buffalo—						
Buffalo St. Railway	Com.	5,370,500	100	5	....	.....
“ “	Bds. 1931.	5,000,000	100	....	F. & A.	.....
Boston—						
West End St. Railway	Com.	9,085,000	50	..	J. & J.	47
“ “	Prf'd.	6,400,000	50	5	J. & J.	77
“ “	Bds. 1902.	3,000,000	100	....	M. & N.	100½
Louisville—						
Louisville St. Railway Co	Com.	5,000,000	100	....	....	.....
“ “	Prf'd.	1,000,000	100	5	A. & O.	.....
“ “	1st Bds.1930	6,000,000	100	....	J. & J.	.....
Newark, N. J.—						
Newark Passenger Railway	Com.	6,000,000	100	....	....	27⅜
“ “	Bds. 1930.	6,000,000	100	5	J. & J.	84½
New York—						
Union Railway Co	Com.	2,000,000	100	....	....	155
“ “	Bds.	2,000,000	100	....	....	.....
Pittsburgh—						
Duquesne Traction Co	Com.	3,000,000	50	....	....	25
“ “	Bds. 1930.	1,500,000	100	5	J. & J.	100
Fed. St. & Pleas. Val. R. R	Com.	1,400,000	50	....	J. & J.	17¼
“ “ “ “ “	Bds. 1919.	1,250,000	100	5	J. & J.	100
Pittsb'gh, Aleg. & Man. R. R	Com.	3,000,000	50	....		37½
“ “ “	Bds. 1931.	1,500,000	100	5	J. & J.	100
Pittsburgh & Birming. R. R	Com.	3,000,000	25	....	....	12½
“ “ “	Bds. 1929.	1,500,000	100	5	M. & N.	95
Rochester—						
Rochester Railway Company	Com.	5,000,000	100	....	....	67
“ “ “	Bds. 1930.	3,000,000	100	5	A. & O.	95
St. Louis—						
Lindell St. Railway	Com.	2,500,000	100	....	Q. J.	72½
“ “	Bds. 1910.	1,500,000	100	5	J. & J.	100
St. Louis & Suburban	Com.	2,500,000	100	....	....	30
Union Depot Railway	Com.	1,200,000	100	....	....	.....
“ “ “	Bds. 1910.	1,000,000	100	6	A. & O.	1

NEW BOOKS.

Reference Book of Tables and Formulas for Electric Street Railway Engineers. By E. A. Merrill, New York, 1894. The W. J. Johnston Company, Ltd., Flexible morocco, 96 pages; price, post paid, $1.

A book for the pocket of the railway engineer or station superintendent. Well bound and of convenient size it is a handy book to carry. The first part of the book is taken up with tables relative to the consumption of fuel and the generation of steam. Proper sizes of chimneys, foundations and approximate dimensions, various styles of electric cars, comprise the next few pages with subsidiary matter. Tables of dimensions of poles, trolley wires, span wires, ties and rails are given, followed by data concerning excavations and embankments. The last sixty pages are taken up with tables of mathematical quantities connected indirectly with railway work. While some of the tables are original others are credited to authorities on the various subjects. The design of the book is that of a reference book for street railway engineers.

The Political Economy of Natural Law. By Henry Wood, author of "Ideal Suggestion through Mental Photography," "Edward Burton," etc. Boston, 1894. Lee & Shephard, 10 Milk st. 300 pp., cloth. Price post paid, $1.25.

The treatment of this subject by the author is in a clear, practical manner lacking the fine reasoning which withdraws most treatises on this subject out of the range of the practical man and places it only where the theorist can appreciate it. The thoughts of the author are well elucidated by examples drawn from the facts of every day life. In fact he has followed closely the work as marked out, the outlining of a political economy that will be natural and practical. In the twenty-four chapters which compose the volume there are briefly treated the more important questions bearing on this subject. Among the titles of the different chapters are the Law of Co-operation, the Law of Competition, Combinations of Capital, Combinations of Labor, Profit Sharing, Socialism, Economic Legislation, Can Capital and Labor be Harmonized? the Distribution of Wealth, Booms and Panics, Money and Coinage, Tariffs and Protection, etc. He treats each subject in a pleasant and vivacious manner, and leaves many hints for further investigation. The reader is not burdened with lengthy discussions, but the thoughts of the author are briefly stated. The volume is an addition of the right kind to the literature on the subject. The business man or popular reader will find it full of interest not only for the matter it contains but also for the lines of thought it will suggest.

The National Electric Light Association's Standard Rules for Electrical Construction and Operation, as revised and adopted at the seventeenth convention held at Washington, D. C., Feb. 28, 29 and March 1, 2, 1894. New York 1894. The National Electric Light Association 136 Liberty St., 35 pages, paper.

These rules have been compiled by the committees that have been appointed for that purpose during a number of years past. The committees have been composed of energetic members and in the work of compiling these rules a careful study has been made of existing rules in connection with the experience and knowledge gained by observation and the installation and operation of various electrical systems. Mr. W. J. Hammer the well known electrical engineer of New York has given a considerable time to the work. The rules in this booklet are believed the most complete of any so far published. It is the purpose of the association to place them in the hands of architects, central station men and others interested and if possible secure their general adoption.

TRADE PUBLICATIONS.

A leaflet issued by the Bryant Electric Company calls attention to the cut-outs, sockets and switches made by the company. Interested parties are referred to the catalogue with the red cover for more complete information.

A very attractive and nicely gotten up catalogue has just been issued by the Cooper-Roberts Co., of Mt. Vernon. Ohio. The cover is very handsomely designed and the contents are well printed on good paper. The cuts are very clear and illustrate the different parts of the engine in an excellent manner. The simple and compound engines designed for electric light, railway power plants, factories, etc , are described in a comprehensive manner.

In the interest of users of water power, Mr. H. E. Olbrich, of Cedar Falls. Ia., has issued a catalogue of Replogle's electric regulators. These regulators are illustrated and described in a very clear manner in this catalogue. It shows how a varying water power may be so regulated as to maintain a constant speed as required in operating electrical and other classes of machines. The methods advocated in the use of water powers are economical and undoubtedly produce the best results.

The Bishop Gutta-Percha Company has recently distributed with its compliments a book of 50 pages, containing the latest revised rules of the Underwriters' International Association as adopted by the New York Board of Fire Underwriters, November 15, 1893; also rules for wiring calculated on the basis of 55 watts per 16-candle power lamp and other valuable information. A number of pages are devoted to the Bishop Gutta-Percha and rubber insulated wires which are used for every kind of electric current and in any place where such lines are run. A specialty is made by the company of furnishing insulated conductors for difficult places such as are found in many buildings like breweries, stables, paper mills or under ground and under water. The little volume is nicely made up and will be found a valuable companion to wiremen and electrical engineers.

The discussion of Dr. Louis Bell's paper on "Pratical Properties of Polyphase Apparatus" forms a part of the "Transactions of the American Institute of Electrical Engineers" as published for March. This discussion amplifies many points brought out in the paper and brings up many closely connected subjects. It makes very interesting and instructive reading. The same number also contains Prof. Wm. A. Anthony's paper "On the effect of Heavy Gases in the Chamber of an Incandescent Lamp," read before the institute at the regular meeting March 21st. The paper discusses the experiments so far made in this direction and the advantages of the use of certain gases as shown by tests made by the author of the paper. In connection with his treatment of the subject he points out the most desirable features of an incandescent lamp from both the standpoint of the user and the commercial producer of electricity.

Primary batteries as used for electric bells, annunciators, burglar alarms, electric gas lighting, etc., are described in a recent catalogue issued by the Miamisburg Electric Co., of Miamisburg, O. The difficulties encountered in the manufacture of batteries for intermittent service are described. The liability of the battery to destroy itself by chemical action when not in circuit, the possibility of short circuits, and in guarding against this the danger of increasing the internal resistance, are mentioned as some of the defects of the dry battery. The Imperial dry battery manufactured by the above company is described and the method of overcoming these difficulties is explained. For use similar to the above a wet battery is described known as the Burnley Cartridge battery, having been invented by Mr. Wm. Burnley. It is a modified form of the LeClanche cell, but instead of the ordinary porous cup, a paper cup is used. This cup is manufactured of prepared paper board and is sufficiently substantial to stand any ordinary service. The carbon used is said to be of special construction and on that account is smaller, requiring a smaller jar for a cell of the ordinary strength.

Under the heading "Anti-Friction Materials" Cassier's Magazine for March publishes an article from the pen of Killingsworth Hedges, M. Inst. C. E. The use of oil as a lubricant, says Mr. Hedges, is to separate the rubbing parts of machinery and to diminish the friction of metal upon metal by an intervening film of oil. If the oil is supplied in sufficient quantity to cause the entire separation of the metals, the friction is reduced to the measure of the viscidity of the oil. Where an insufficient quantity of oil, or a poor quality, is used, friction is caused by the interlocking of the metals forming the revolving and stationary parts of the bearings. It is a well-known fact that heavy lubricants effect a better separation of the metal, and with less wear and tear, than those lubricants that are more limpid. This being so, attention has naturally turned to solid lubricants and of all the various materials tried, none has proved equal to graphite, and of the various forms of graphite, flake graphite has reduced friction and cured hot bearings most successfully. The conditions of success, so far as lubrication with graphite is concerned are: The graphite must be soft and yielding, absolutely pure, free from grit and the flake of uniform size. The Joseph Dixon Crucible Company, Jersey City, N. J., have also lately issued and is distributing an interesting pamphlet on this subject, in which they have embodied a generous amount of scientific and practical information.

PERSONAL.

Mr. Geo. A. McKinlock, president of the Central Electric Company, has gone to Old Point Comfort, Va., for a couple of weeks' rest and recreation.

Mr. T. E. Crossman, who has for a long time been the official stenographer of the National Electric Light and the American Street Railway Associations, has decided to enter business for himself and has therefore opened an office at 166 Montague St., Brooklyn, N. Y. The reports of Mr. Crossman have invariably been very satisfactory and his many friends still wish him every success in his new enterprise.

Mr. Geo. P. Low has resigned his position on the Electrical Engineering Staff of the California Midwinter International Exposition. Mr. Low was appointed to this staff to effect the installation of the Fire Alarm Telegraph System, to draft all plans and specifications for wiring, to personally superintend the same, and to furnish such information and advice as was necessary in reference to the practical detail of electric wiring. This being accomplished Mr. Low found it necessary to resign from the Midwinter Fair in order that he might devote his time to his personal business as consulting electrical engineer.

BUSINESS NOTES.

The McLean Armature Works, Chicago, report that they are now very busy on electric street railway work, of which they make a specialty.

The Chicago Rawhide Manufacturing Company, Chicago, reports a very decided improvement in the number of orders recently received for all of its different lines of goods, including dynamo belting, etc.

J. J. Murray & Company, Philadelphia, are at present especially busy in filling orders for their well known glass specialties for arc and incandescent lighting, being compelled to run their works on full time.

The Heine Safety Boiler Company, St. Louis, Mo., has just closed contract with the Edison Illuminating Company of that city for fifteen 375-horse power Heine safety boilers. These boilers are to replace those of another make known as the Rohan boiler.

S. R. Sikes & Co., 915 Wash Ave., Minneapolis, Minn., has just completed a handsome belt, 125 feet long and 40 inches of two-ply leather. A very good business is being done in the special brands of oak leather belting in the manufacture of which 150 picked butts are handled each week.

Chas. E. Gregory Company, 47 & 49 S. Jefferson St., Chicago, reports that the demand for second hand apparatus which it makes a specialty of handling is at present unusually great. The amount of business done by the company during the month of March was the largest since it began business.

Lincoln & Company 934 Monadnock Blk., Chicago. is the name of a new firm acting as manufacturers' agent and handling a general line of electrical supplies. A specialty is made of carbons, porcelain goods and wire. Every thing required in construction work and for factory use is kept in stock. Incandescent lamps in the regular sizes are also carried.

The Electrical Appliance Company, 242 Madison St., Chicago, reports a more lively trade in general supplies. A number of new specialties have been placed before the trade. The Allen soldering stick is among the latest and sample sticks are being tried from the Atlantic to the Pacific. The increased demand for many lines of goods has been sufficient to warrant the carrying of a large stock. This is especially true of porcelain goods, cleats, insulator and tubes, Packard transformers, the swinging ball lightning arrester, etc. In the standard line of house goods a number of large orders for complete equipments have been received.

The Short Electric Railway Company, Cleveland, Ohio, held its annual meeting March 27th. The old board of directors were re-elected. At the meeting of the directors B. F. Miles was elected president; Bethune Duffield, secretary and treasurer, and S. M. Hamill, general manager.

Wm. Baragwanath & Son, Chicago, recently received an order from the Edison Illuminating Company of St. Louis, for two 1,500-horse power heaters. This is one of the largest orders that has been placed for heaters of late, and it reflects great credit on the firm for having secured the order. In addition to this the firm reports the outlook for other business improving.

The Elson & Brewster Engineering Co., the New York representative of the W. S. Hill Electric Company, of Boston, Mass., is obliged for the second time this year to move to larger quarters. The company is now located at 143 Liberty St., where it has every facility for handling the large stock which it is now carrying, and for the transaction of the constantly incrsasing business.

Edward Lasell & Co., 225 Dearborn St., Chicago, are mailing to their customers a pamphlet descriptive of their telephones, magneto bells, and telephone switch boards, etc., etc., made by the Viaduct Co., of Baltimore, for whom they are general western agents. "Monarch" Incandescent Lamps made by this company are giving entire satisfaction to a large number of their patrons.

The W. S. Nott Company, Minneapolis, Minn., has furnished a great many diamond belts to electric stations and power houses. For three years two oak belts 73 inches wide and 150 feet long have been in constant service in the power house of the Twin City Rapid Transit Co., which came from this factory. The company is using a large amount of leather in the filling of present orders for belts.

The Brush Electric Company, Cleveland, Ohio, at its regular annual meeting re-elected the old board of directors. The officers of the company for the coming year are president, W. H. Lawrence; first vice-president, C. A. Coffin; second vice-president and general manager, S. H. Hamill; treasurer, R. F. Miles; general council, Wm. B. Bolton; secretary, A. H. Hough; assistant general manager, L. H. Rogers, and superintendent, C. W. Phipps.

The James Hunter Machine Company, North Adams, Mass., recently announced to the trade that it would handle exclusively and sell direct all goods which were formerly distributed from its factory through H. H. Bates & Co. of Boston. The Boston office is in charge of Mr. Richard H. Hill, a mechanical engineer of acknowledged ability. The Hunter friction clutch pulleys, cut offs, couplings and power transmission machinery are well known among power users.

The Manhattan Electrical Supply Co., New York, announces that its salesrooms will hereafter be found at 32 Courtlandt St., on the ground floor. The limited space at 36 Courtlandt St. necessitated a change, and the new location affords more commodious quarters, and better facilities for handling its trade. The company manufactures most of the electrical goods it handles, and therefore is able to sell them at very low prices. A catalogue has recently been issued by the company of its telephone supplies.

The Dodge Manufacturing Company, Mishawaka, Ind., will open an eastern office at 43 & 45 Dey St., New York, where it will occupy the entire building five stories in height and basement. The offices and warerooms will be ready for occupancy about May 1st. One of the most complete stocks to be found anywhere in the country will here be kept of all power transmitting appliances, including the Wood split pulleys, one of the principal specialties of the company. The new store will be under the general supervision of Mr. M. W. Mix, who is also the manager of the Chicago office of the company.

The L. K. Comstock Company, Monadnock Blk., Chicago, placed last week a large force of men at work in the Leland Hotel installing an isolated lighting plant. The company has the contract for the entire equipment from the engines to the outlets. The specifications call for 2,600 lights. This company enters the field with a reputation second to none, which has been made by its president in installing complete electrical equipments in some of the the largest and finest office buildings recently erected in Chicago, together with many plants in neighboring towns and cities.

Mr. Wells Goodhue, Monadnock Blk., Chicago, will hereafter conduct under his own name the business formerly carried on under the firm name of Goodhue & Lincoln. Mr. Goodhue is well known in the electrical trade, and feels confident that he can offer many advantages to intending purchasers. He will continue to handle the same specialties that he has so long been identified with, among which are the Wagner direct and alternating current power motors, Wagner fan motors, Sunbeam lamps, and a line of second-hand Westinghouse and Slattery transformers, that he has already sold a great many of.

The Ball & Wood Company, 15 Cortlandt street, New York, sent out several hundred invitations to engineers, steam users and the trade press to visit the works of the company at Elizabethport, N. J., Saturday afternoon, March 31st, to inspect the new vertical 600-horse-power engine which had been completed and was about to be shipped to the Chicago Edison Company for one of its central stations. Railway tickets accompanied the invitations and everything was prepared at the works for the comfort and convenience of the guests. Between three and four hundred persons accepted the invitations and witnessed the engine run and afterward inspected its construction and designing.

The Ball Engine Company, Erie, Pa., manufacturer of the well-known Ball engines report a large number of recent orders and the approach of a more prosperous season of business. Among the recent orders and shipments are the following to public buildings and institutions: Two 100-horse power engines, to the Criminal Court Building, Chicago; one 100-horse power engine, to the House of Correction, Chicago; one 60-horse power engine, to the Illinois State Reformatory, Pontiac, Ill.; one 100-horse power engine, to the Industrial Home for the Blind, Chicago; two 100-horse power engines, to the State Asylum for Chronic Insane, Wernersville, Pa.; one 135-horse power engine, to the Willard State Hospital, Willard, N. Y.

The Central Electric Company, Chicago, is to remove about May 1, to 173 and 175 Adams St. The building which is to become its new home is now in the hands of the decorators and furnishers in order to make it conform to the requirements of this enterprising company. The size of the building is 150 by 175 feet and is one of the most convenient and centrally located points in the city for an electrical supply warehouse. It is thoroughly equipped with passenger and freight elevators operated by electricity, and every facility will be here found for the convenient and prompt filling of orders. Among the recent agencies taken by the Central company is that of the Helios arc lamp for alternating incandescent circuits, the sales of which it will push throughout the West with its usual vigor. Among the other leading specialties of the company may be also mentioned the iron armored conduit of the Interior Conduit & Insulation Company, the Hardmuth cored carbons and the well-known Okonite wires and cables, the orders for which despite the recent dull times, have never ceased to come in.

Fisher & Porter, 1025 Monadnock Block, Chicago, Ill., report that they see evidence of a good business in the immediate future. They are equipping with machinery, for W. H. Roessle, of Pittsburgh, a gold mine at Tellico Plains, Tenn., and have supplied Kotine, a new material for painting iron structures, for the new Lincoln park bridge, recently erected by the Pittsburgh Bridge Co. They have the contract to supply two 75-horse power M. A. Green engines for the Leland hotel in Chicago, and have several contracts of a similar nature, ready to be closed. They have advices from the home office of the Altoona Mfg. Co., that the works are running full time with a complete complement of men, and are turning out engines as fast as their equipment will allow. One 150-horse power engine for the Farmington Light & Power Co., Farmington Ill., and one 125-horse power engine for the Western Glass Co., of Colorado City, Colo., are among the plants recently installed in the West.

The National Water Tube Boiler Company, of Brunswick, N. J., caused considerable surprise when the bids for the 1,800-horse power of boilers for the pumping station were opened by the St. Louis water commissioners on Feb. 10. Its bid was nearly 20 per cent the lowest and 40 per cent lower than the highest. This was more suprising when the usual careful and conservative methods of the company were considered. A careful reading of the specifications shows that a premium of $250 is provided for by the commissioners on each of the six boilers for every per cent of efficiency above a given amount with a corresponding forfeit for each one per cent below that amount. This clause was inserted for the express purpose of obliging each bidder to guarantee its boilers. The National company knowing the work of its boilers offered a bid which was considerably below what it would have been did it not expect to receive a bonus for its boilers. The commissioners, although paying a bonus for its boilers will, however, have a good bargain on account of the great economy in the work of the boilers. The proposition was novel and shows the confidence of the different bidders in their boilers.

Chas. A. Schieren & Company, New York and Chicago, has received very flattering reports from users of its belts on the Pacific slope. The electric leather belts are known wherever electric machinery has come into use. The following letter tells its own story:

Office of Risdon Iron & Locomotive Works.
San Francisco, Cal., Feb. 23rd, 1894.

Messrs. Chas. A. Schieren & Co., 45 Perry St., New York.

Gentlemen: The following is copy of a letter received from one of our customers, the president of the Union Ice Co., to whom we furnished your belts last summer:

"The two double perforated electric leather belts I purchased of you last summer for the Union Ice Co. factory, Mentone, San Bernardino, Co., Cal., are doing splendidly. The 20-inch belt on 26-inch motor pulley has a velocity of about 5,000 feet per minute. The 30-inch belt has a velocity of about 3,000 feet per minute. Each transmits 1,500-horse power and are as perfect as when first put on. Yours truly,

"Risdon Iron & Lomotive Works."

By Mr. Thos. J. Barbour."

ELECTRICAL INDUSTRIES.

Vol. V. CHICAGO. May, 1894. NEW YORK. No. 5.

Electrical Features of the Mid-Winter Fair.

While permitting of no comparison with the World's Fair just closed at Chicago in respect to the number of exhibits, the California Mid-Winter International Exposition now being held at San Francisco is not far, if indeed at all, surpassed by the great World's Fair in the variety of its exhibits. This is especially the case as regards the exhibition of electrical machinery, which includes apparatus from all the prominent electrical manufacturing concerns, with the exception of the Brush and Westinghouse companies and as the exhibits are all purely practical and put in regular daily service for the lighting and operation of all the various branches of the Exposition, an exceptionally good opportunity is offered for comparison of the merits of the various machines.

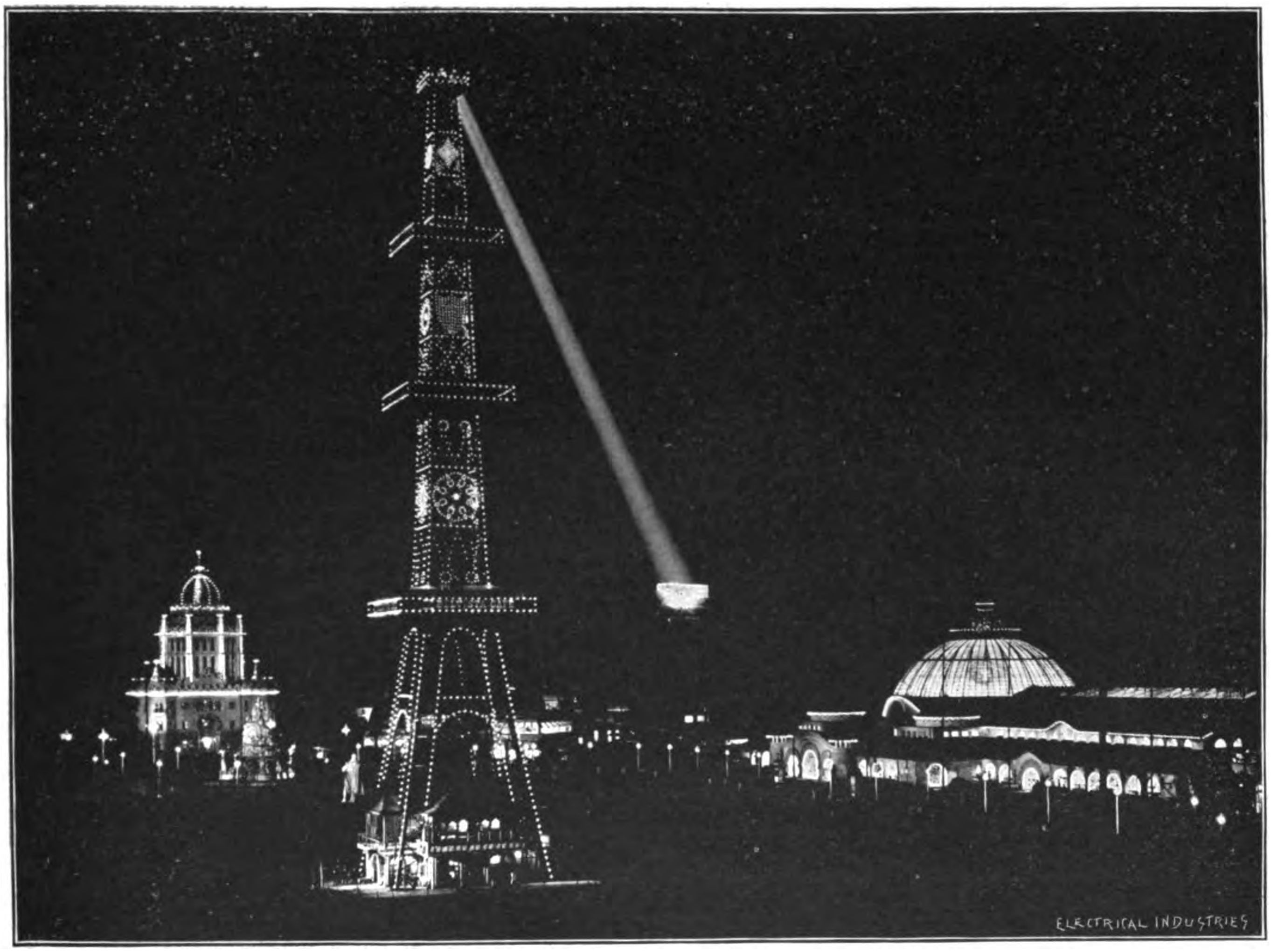


FIG. 1.—ELECTRICAL FEATURES OF THE MID-WINTER FAIR.

Among the apparatus displayed are power generators for street railway work and car trucks with motors attached; generators and motors for long distance power transmission by multiphase currents: motors, multipolar and bipolar, high or slow speed, for direct or alternating currents; generators for direct current arc lighting and for incandescent illumination; search lights and electric head lights; storage batteries; and a great variety of apparatus, illustrating the special applications of electric currents in the accomplishment of various purposes.

Through the excellent taste displayed by Director-General De Young and Lieutenant W. F. C. Hasson, Chief of the Electrical Department of the Exposition, the effect of night illumination of the grounds has been made specially attractive and includes some features that are absolutely new and novel and have never been attempted before at any exposition. The principal lines of the main buildings situated around the Grand Central Court or Plaza are outlined in incandescent lamps in a manner similar to that adopted for the World's Fair buildings and the effect is equally pronounced and beautiful. An electrical fountain is located at one end of the Grand Central Court or Plaza, it being one of those used at the World's Fair and transplanted.

But the central and by far the most conspicuous feature of the entire Exposition and that which is seen long before the visitor enters the Exposition grounds and long after he is on his homeward way again, is the tall, graceful electric tower placed in the center of the Grand Court or Plaza. The level of this court is depressed some ten feet below the level of the ground upon which the main buildings are placed around about the Grand Central Court. Upon the higher level is also the principal roadway and a fine cement walk, which together form the main thoroughfare and promenade for the visitors. Viewed from this elevation the tower presents a magnificent spectacle which is in a measure reproduced herewith by views taken of the tower while in operation at night and which gives an idea of the splendor.

The contract for the lighting of this tower was awarded to the Western Electric Company of Chicago, having been secured by Mr. C. D. Crandall, manager, and all the details of the electrical construction and the design of its illumination was left with that company. The work was placed in the hands of Mr. E. W. Goldsmith, one of the company's experienced lieutenants by whom the details were worked out and construction superintended. The tower rises 265 feet from its base and 3,260 incandescent lamps of 16-candle power each, are utilized in its decoration. Of these approximately 1,000 are used for outlining the tower; 1,000 for the constant decorative light effects; and 1,260 in the varying light effects of the geometrical designs placed midway between the different platforms of the tower.

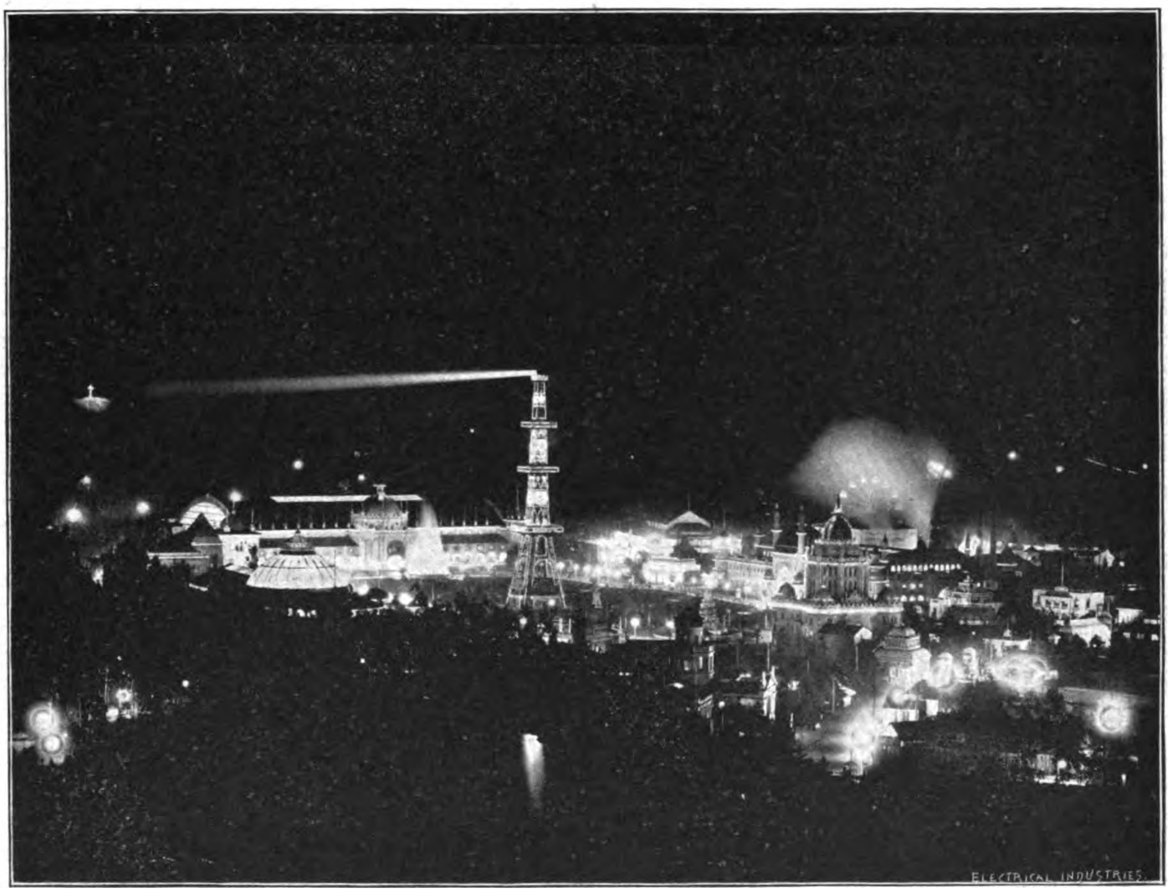


FIG. 2.—ELECTRICAL FEATURES OF THE MID-WINTER FAIR.

Current is supplied to the tower by rubber covered conductors placed underground in wood ducts, it requiring the equivalent of 1,500,000 circular mils in each conductor and about 30,000 feet of wire to carry the current from switch to outlets. These conductors terminate in one of the booths of the Kiosks under the tower where the general distributing point for the tower circuits is located. Here is also the switchboard which contains the switches controlling the various circuits. The automatic switch which gives the lamps forming the geometrical designs their peculiar varying effects is also placed in this booth. This rotating switch has a capacity of 120 circuits and is operated by an electric motor. Air blast is utilized for blowing out the arcs formed at the carbon points of the switch as the break in the circuits is made. The current used is of 220 volts pressure and lamps are wired by connecting two equal groups of multiples in series for all the constant light effects and multiples of two lamps in series, for the varying effects which are thus more perfectly under control. Although the accompanying cuts show some of the designs on the tower it would be impossible to show the intricate designs which when lighted are constantly changing in form and color. It is impossible to describe the beauty of the effects produced.

The electrical construction work has been carried out so that the airy aspect of the steel structure is not in the least impaired. This was easily accomplished by mounting the lamps upon wood strips where the light outlines followed the principal lines of the tower, but the solution was more difficult in the case of the geometrical designs. The object was, however, successfully accomplished by the use of wire netting of about one inch mesh stretched on frames, the lamps being supported by means of two wood discs clamping the wire netting, the discs being scarcely larger than the base of lamp sockets employed. The frames with this netting were wired and completed in all details on the ground and then raised and fastened to the sides of the tower by means of clamps and steel tie wires. The electrical connections were then made to the terminal of the cables making connection through the switch.

By this method of construction it is scarcely perceptible in daylight that the tower possesses any electrical features, thus retaining its graceful outlines, and preserving perfect harmony with the surroundings.

On the extreme top of the tower is a search light, 60 inches in diameter which was used on the Colonnade at the World's Fair last summer and which was said to be the most powerful search light so far constructed. It excites much interest as its rays are thrown upon the observatory on the summit of Strawberry Hill in Golden Gate Park, or on other prominent points in the vicinity. An electric elevator carries passengers to the third platform, an elevation of approximately 200 feet. It is well patronized, an eminent success and will do much towards increasing the sale of this apparatus in the larger cities of the Pacific coast.

In Figs. 3 and 4 are shown views of one of the electrical exhibits, that of the Western Electric Company. The exhibit is almost entirely of a practical nature although several of those novelties that attracted so much attentton at the World's Fair are shown. The machines that furnish a large part of the lighting effects form part of the exhibit. The line of goods exhibited include more particularly the line of central and power station machines and devices. The various lighting systems manufactured by the company are well shown. The floor space covered by the engines, dynamos and controlling devices covers nearly one half that devoted to the electrical exhibits in the main Mechanical Arts building and a block forty by fifty feet in the annex.

The apparatus exhibited includes two 150 kilowatt multipolor generators which operate 3,600 16-candle power incandescent lamps on the central tower. These generators are operated by a 600-horse power engine built by the Union Iron Works of San Francisco. An interesting combination is shown in Fig. 4 consisting of three machines connected together. The two machines connected together and having a common pulley are both generators, one generating current at 110 volts for the scenic theatre and the other at 220 for motors of exhibitors. Driving these machines by means of a link belt is a 500 volt motor of 80-horse power capacity. This combination is only used in the day time where 500 volt current alone is available. At night the 320 volt machine runs as a motor operating the 110 volt dynamo. At times for exhibition purposes the 500 volt motor is run by the 220 volt machine for the generation of 500 volt current.

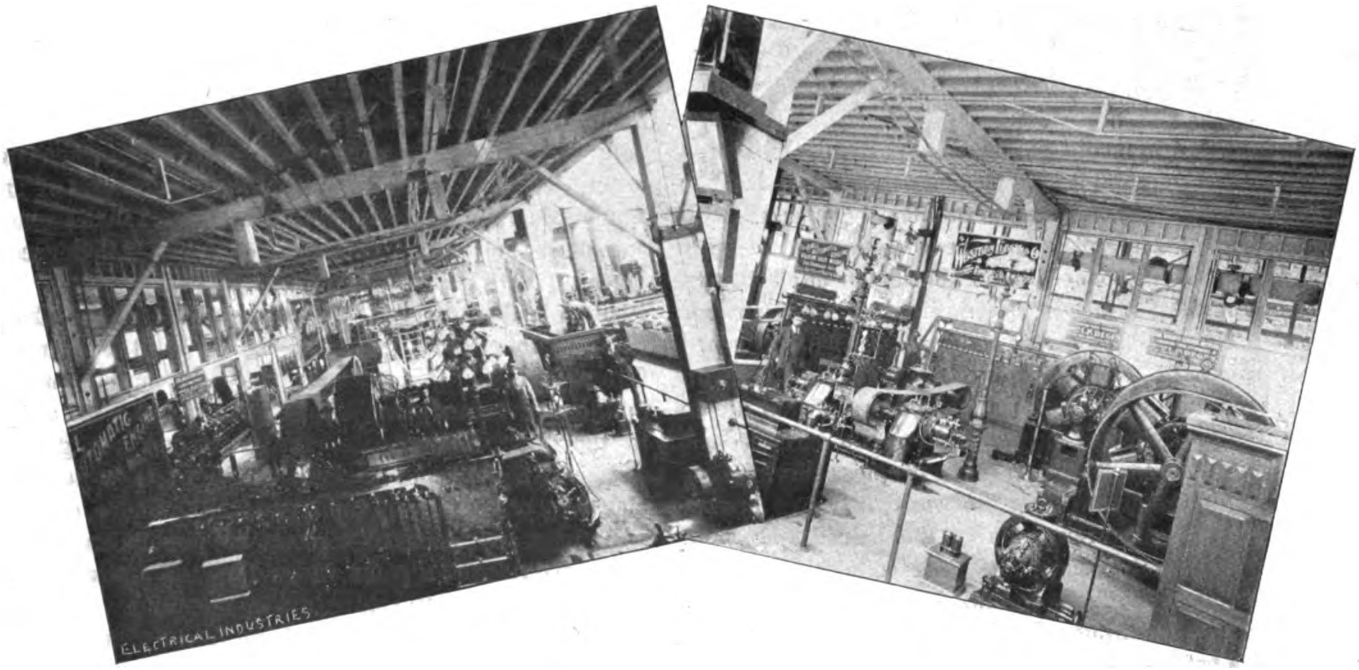


FIG. 3.—ELECTRICAL FEATURES OF THE MID-WINTER FAIR.

A number of ring type motors are also exhibited and several attractive novelties are displayed. The machine with "W. E. Co." in incandescent lamps behind which a pointer moves, giving the lamps the appearance of being lighted and extinguished by the pointer, the card writing machine which automatically writes the name of the company on a business card are among the novelties. Directly above and in front of the space is a large electric headlight that swings back and forth across the building attracting the attention of visitors in that direction. Illuminated pictures of prominent buildings in which the apparatus of the Western Electric Co. is installed are hung about the space. Artistically designed lamp stands, hangers, electroliers, etc., together with the active exhibit gives the space a lively appearance.

The scenic theater which is fitted throughout with theatre apparatus of the Western Electric Co., forms one of the Midway attractions. The various phenomena of a complete day are there reproduced. The gradually advancing day until it reaches its greatest splendor, then its fading away, the glories of sunset, the evening, the night, with storms, thunder and lightening are all reproduced.

Another part of this company's exhibit is its arc lighting plant consisting of four 50 light arc machines which furnishes the current for the lights in the Manufacturers and Liberal Arts building. Two switch-boards, complete with everything used in a central station, are here shown. They are 14 feet long, of Tennessee marble and finished elaborately. These trimmings as well as the various instruments and attachments on the board are finished in Japanese copper finish, making a handsome board both in color and design. The entire equipment is of Western Electric manufacture and furnished a most effective exhibit. It has attracted the attention of a large number of visitors from the Pacific coast many of whom were unacquainted with the great advancement in the electrical industry and its universal adoption for lighting and power.

For lighting the district of the Champs Elysees, Paris, the central station and system of distribution was completed last year. The dynamos, the system being the alternatiug current, were built by Messrs. Hillairet and Huguet, of Paris, and are at present three in number. The armature is stationary, and the field magnets revolve; they are 19ft in diameter, have eighty poles, and are keyed on the engine shaft. The fixed armature has eighty bobbins, and gives 133 ampères at 3,000 volts, with a periodicity of forty per second. The output can be increased to 455 kilowatts in case of emergency, and the guaranteed commercial efficiency is 85.5 per cent.

The Joint Business of Gas and Electric Light.*

BY DR. HOWARD JONES.

It is rather presumptuous in one like myself to appear in the role of instructor before gentlemen who have devoted their lives to the business of producing light, and are practical engineers, especially as the business of producing gas and electricity for light is known to me mostly in theory, and when studied at all only as a pass-time. Yet it is within the memory of man when the gas industry of Ohio and other localities was in need of such facts as I have at my disposal, and I understand there are still some in the gas trade who desire more light when electrical matters are talked of.

In small towns the lighting is often divided between two or more companies, with the result of cutting down the dividends of the gas company and the electric company to a point where net profits sometimes cease to exist. It can be asserted without much danger of refutation that incandescent electric companies in small towns have seldom if ever earned a reasonable dividend. It is upon the desirability of combining the gas and electric interests of such towns, with a view of making each more profitable, that I wish to speak, and the specific figures which I shall present to you are given with a feeling that their correctness can be depended upon.

The town of Circleville, O., has been particularly favored by the electricians, and it is in this city that I have had the opportunity to study the various problems connected with arc lights for streets, and gas and incandescent electric lights for indoors. To persons with no knowledge of electricity, there is a mysticism about electric lighting which breeds respect. The qualifying word "wizard" was early attached to the inventor of Menlo Park. These facts, together with others that want of time forbids mentioning, created a halo around the promoters of the new light in its earliest days, which clung to them for years. The people, believing they were living in the greatest age the world had ever known, accepted all the advertisements of the haloed fraternity, and emptied their pockets into their coffers, hoping to receive in return enormous profits, because electricity was produced from nothing. Produced by simply turning a coil of wire between magnets.

The gas companies, "damned monopolies," were the great targets of these perpetual motion electric promoters, and the gas industry was partially paralyzed by the great wealth and the ill-nature it saw piled up against it. Then came reaction, and the clouds of bankruptcy here and there obscured the halo. The new industry was found by investors to be a delusion and a money-losing investment of the first-class. Investors in local companies, while cursing the gas monopoly as being next only to the imaginary Satan, had created by their generosity the greatest, meanest, "octopian" monopoly the United States or any other country ever saw.

At places, the gas industry was damaged beyond repair, while citizens lost fortunes in opposing electric ventures. To day the varnish is off the toy, the child has grown to the man. The "wizard" business no longer catches capital. The gas companies are seldom mentioned by electricians as monopolies. It has been discovered that to succeed with the subtle electric fluid, the same business principles and sense must be used as in other undertakings. Upon the other hand, some of the opponents of the electrical enthusiasts are still bearing malice, are still prejudiced to the point of blindness. Now if I can show you the commercial relation which electricity to-day bears to gas, I shall feel that I have accomplished the purpose of your request.

Circleville has about 7,000 inhabitants. In 1859 a coal gas plant was established with gas at $5 per 1,000 cubic feet. This plant did a good business from the start, and in 1885, when the Edison people captured the town, was selling at $2.50 per 1,000 and earning good dividends. Early in 1884, a 1,000 Edison incandescent electric plant turned on its current under flying colors. Thirty-two stockholders were resident store-keepers and business men. At a public banquet 50 per cent dividends were promised. At once the price of gas was dropped to $1 per 1,000 feet, and the fight was on. The combat was one of capital and influence with a beautiful new invention, against a rich and cursed monopoly, with the result that each plant lost money. The Edison plant in two years had expended $55,000. In 1888 the two companies, seeing the fate ahead, combined, and raised the price of gas to $2 per 1,000 cubic feet, and the incandescent current to the same ratio. For two years the companies made money. In 1891 the gas contract for street lighting expired, and the citizens demanded arc lights. Each company decided to bid for the lighting, and, after considerable wrangling, the gas company obtained the contract to light 119 or more 1,200 candle power arcs for ten years, at the rate of $75 each per year. The gas company at once began construction, and at the same time arranged for power for an alternating incandescent circuit. The price of gas was reduced to $1.50 per 1,000 to small consumers, and scaled down to 75 cents per 1,000 according to quantity and time of day of consumption. This resulted in the purchase, in February, 1892, of the Edison plant, by the former gas company, for a little over one-fifth of its cost. Its machinery was soon moved into the building of the arc plant, which was erected with an eye to the event, and now for two years and over, gas, and electricity for arc and incandescent light, have been furnished by one company from, practically, under one roof.

Without any material increase of population, the gas sales have reached a point where they are quite satisfactory. Only about 100 stoves are in operation. This field, we believe, has before it a promising future. Incandescent current is sold partly by meter and partly by contract, but after May of this year no more contracts will be made for more than 3 lamps, to a single individual. There is a great disposition on the part of citizens to have incandescent light in their dwellings and places of business. By meter the current sells at the rate of $1.60 for 10,000 watts, or $1.60 for 100 milligrammes (Edison meter), but this small difference of 10 cents above the price of gas does not deter people from using it in preference. The simplicity, the convenience, the freedom from smoke, smell and dirt recommend it strongly to the modern housewife.

To be able to light up a closet, cellar, stable, or any room or place which you are about to enter, by simply turning a switch, is fully appreciated by this utilitarian age. The incandescent light is gaining slowly but surely over gas for illuminating purposes. To-day this plant has over 2,100 sockets hung, running through 200 services. The number of gas meters for light is about 300. The comparative sales of incandescent current to gas are in ratio of 6 to 9, and I believe that before long it will be as 9 to 9. The profit upon the incandescent current is not large. In fact it is far from sufficient. In proportion to the capital invested in each, the incandescent plant earns 50 cents when the gas earns $1, but this estimate includes the profit from gas sold for heating as well as lighting. The lamps are sold to the customer at about cost.

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*Read before the Ohio Gas Light Association at Columbus, O.

The arc system in use is the Fort Wayne. Three machines of 50 arcs capacity each are run. They have given perfect satisfaction to the plant and to the city. No serious difficulty has been experienced with them. The lamps are the Wood double ratchet. Not more than one or two fail to start at a time, and frequently the entire 119 start up. There are 3 circuits of a combined length of nearly 20 miles. The earning capacity of this plant in proportion to the money invested is about equal to that of the gas plant or double that of the Edison plant.

If the arc plant were to run by itself it would not make money under our present contract. A few accidents would in fact make it a loser. Running all dark hours amounts to about 2,500 a year. In 1893 we ran 2,534 hours. Counting one arc in the engine-room, we operated last year 120 arcs, consuming at a fair allowance 120 indicated steam horse power each, 2,534 hours. The number of arcs (120) multiplied by the number of hours (2,534) will give the horse power hours (304,080). We used about 5 pounds of coal to develop each indicated horse power; this makes the total amount of coal for one year equal 760 tons, which at at 90c per ton, cost $684. Actually we do a little better than this. The other items of expense for one year, if the plant were isolated, are as follows:

Carbons	$600
Water	75
Oil and waste	70
Taxes	225
Insurance	150
Total	$1,120

Superintendent	$1,000
Engineer	720
Fireman	600
Two trimmers	1,080
Extra labor	400
Total labor	$3,800

The item of wear and tear has been variously estimated. Five per cent of the cost of the plant seems to me a reasonable amount. Fifteen hundred dollars added for wear and tear brings the total expense for one year to $7,104. The income from 119 lamps at $75 each per year is $8,925. This leaves a balance in round numbers of $1,800 for net earnings, or 6 per cent on the investment of $30,000. Evidently a very small interest, considering the doubtful condition of the undertaking. A single accident might wipe out several years' profit. Such a plant combined with a gas and an incandescent electric plant will show better for the shareholders, and consequently it is of importance to every city to have such a combination, as this is their only hope for cheap light.

When run in combination the items given above are practically the same, with the exception of labor. In this department the cost is divided. There is, in addition to the labor enumerated, the salaries of the officials of the company, which must be borne in common. One-third the time of superintendent, president, secretary and treasurer, amounting to $1,110, must be added to one-half time of engineer, $360; one-half time of fireman, $300; two trimmers, $780; one-half-time of wiper, $180; extra labor, $480—making a total of labor of $3,210. To this add for coal, carbons and other items stated above, $1,804, and $1,500 for wear and tear, and we have a total of $6,514 as the cost for running for one year. This amount deducted from the income leaves $2,411 net, or 8 per cent on the investment.

The Edison plant has about $2,100 sockets hung, and every night carries a maximum load of about 400 amperes, excepting during the holiday season, when this amount is considerably exceeded. We have a small engine and dynamos to carry the load during the latter part of the night and during the daytime. To run this plant by itself, one year with collections for the year of $6,000, costs as follows:

Superintendent	$1,000
Engineer	600
Fireman	480
Boy	360
Extra labor	360
Total	$2,800

Oil and waste	$70
Water	60
Tax and insurance	350
Wear and tear (6 per cent)	1,500
Coal	500
Total	$2,480

Making the amount of $5,280, or net earning of $720. Valuing the plant at $25,000, its earning capacity is found to be about 2.9 per cent. These figures are upon a scale of strictest economy. This same plant in combination with the arc light and gas can be operated one year, with the same output and the same income, for the following cost:

Supt., Prest., Sec. and Treas., one-third time	$1,110
Engineer, one-half time	360
Fireman, one-half time	300
Wiper, one-half time	180
Office man, one-half time	180
Part time of one trimmer	180
Extra labor	180
Total for labor	$2,490

Other items remaining the same as when plant was isolated ($2,480) makes total expense for one year $4,970. A net profit of $1,030, or 4 per cent on the capital, $25,000. This seems an inadequate interest for such a perishable investment, and so it is; but it is better by far than to have the incandescent plant in opposition hands. The item of depreciation has not been considered, except as it occurs under wear and tear. If in a series of years the arc or incandescent, or both, shall be displaced by something better, then, of course, dividends would be swallowed up.

If you are owner of a gas plant you may say: "Let the other fellow go into the incandescent electric light business. Let him lose his money. He will finally go out of the venture a wiser but sadder man." In fact, he will do nothing of the kind. Once in he will stay in. He will continually increase his income. He will enlarge his business in spite of you. Materials necessary to maintain the station are becoming cheaper and cheaper, and as time goes on the earnings of the station will be larger and larger, and finally the sale of incandescent light in small towns will equal if not exceed that of gas for illuminating purposes.

I shall not discuss the many reasons why incandescent electric lighting is financially a failure. Conditions are changing year by year, and ultimately it will become a commercial success. Electricians know that but few incandescent plants are profitable. Mr. George Cutter of Chicago recently said he did not know how to make private house incandescent lighting a money-making business. Yet I believe that within a few years, without the discovery of any new principle or new application of an old one, such lighting will be profitable. For small towns the direct current seems preferable to the alternating.

Gas men are well aware that 18-candle gas, burned in a common tip, is considerably better as an illuminant than the glow electric lamp, but the advantages of the glow lamp enumerated above, more than compensate, in the minds of many, for its inferiority in illuminating qualities. In order to place incandescent electric light and gas light manufactured by one company upon the same dividend paying basis, the electric light should sell at about one-fourth higher price, light for light.

In regard to the annoyance of the two systems, we find more trouble in the production of gas than in the production of electricity. In other words, there is less trouble and worry, less constant vigilance required in running and maintaining electrical machinery than in manufacturing gas. The difference is not striking, because each requires skillful watchfulness to avoid errors and accidents; but there is a difference, and I believe it is against coal gas. It requires more learning and more training to maintain a constant supply of good coal gas, without mishaps or accidents, than to attain the same efficiency in the production of the electric current, either arc or incandescent.

We are not pushing one light upon the people and holding back the other. We are treating the public fairly in the matter and are supplying whichever is preferred. The gas furnished is seldom over 18 candle power, or under 16 candle power. We endeavor to have it 17. The voltage of the electric current is maintained to standard, and we aim to furnish long-life lamps. The entire condition is satisfactory to us. Consumers seem content with prices, and we feel that we have before us a future not all thorns. While our earnings are not at present such as would satisfy some investors, yet we feel assured of our position with the citizens, and hope always to deserve the same kind feeling which most of them now accord us.

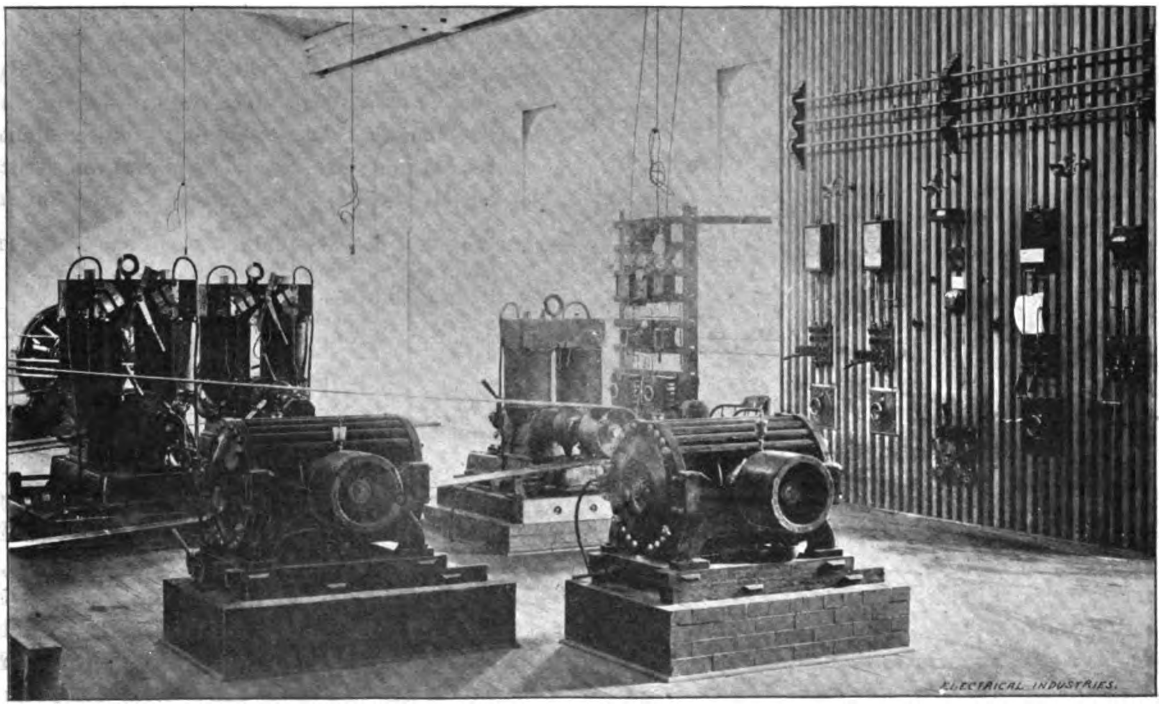

FIG. 1.—ELECTRIC LIGHTING IN HONOLULU.

What is said will be one of the finest central stations in the southern states, is being constructed for the Brush Electric Light Co., at Baltimore, Md. The dynamo room is 13 feet square.

Electric Lighting in Honolulu.

The change in form of government and the attitude of the United States government toward Hawaii has kept the attention of the public fixed on the Sandwich or Hawaiian Islands for several months. The history, commerce and industries of these islands have been matters of particular interest. Their location in the center of the Pacific makes them an important station in the line of steamers between North America and the Polynesia. The projected cable line, while giving them immediate communication with the outside world, will also increase the importance of their position. They will form the connecting link in the telegraphic cables that will then encircle the globe.

Electricity in its many applications has been quite generally adopted and its advantages for light and power are well appreciated. Honolulu, the principle city of this new republic, situated on Oahu, one of the central islands of the group, has two central lighting stations. One of these stations is owned by the government and furnishes besides the street lighting about 1,000 incandescent lights to private parties. It is run by water power and it is said furnishes a very satisfactory service. The other central station is that of the Hawaiian Electric Co., whose station is illustrated in the accompanying engravings.

This company was organized in 1891 with a capital of $20,000 for the purpose of supplying electric lighting. A station was erected on King street with a capacity 800 16-candle power incandescent lamps. A number of motors were operated from this station during the day. As there is no gas plant on the island the demand for light and power rapidly increased. In January, 1893, a franchise to erect poles and string wires in the streets of Honolulu (contrary to the usual custom in the United States) was sold to the highest bidder. This franchise was purchased for the company and in May last the Hawaiian Electric Co. was reorganized with a capital of $150,000 for the purpose of supplying more fully the requirements of the city. The following officers were elected to take charge of the affairs of the company: President, Wm. G. Irwin; Vice-President, Alexander Young; Treasurer, W. W. Hall; Secretary, E. O. White, and Auditor, Godfrey Brown.

For the erection of a station four lots were purchased on the Esplanade, corner of Alakea and Halekauwila streets. The station is a large and substantial brick structure with a neat and ornamental exterior although planned with special reference to the accomodation of the electrical plant. In the construction of the foundations both for the building and the machines the earth was excavated to the coral rock and the stone foundations built up from this base. High ceilings and as perfect ventilation as possible has been secured. The boiler and engine rooms are entirely separate and ventilating skylights reach the entire length of the roof. The trusses supporting the roof have been made of sufficient strength to support any machinery required to be handled in the station. The boiler room is of ample size for the boilers and storage for coal. The foundations are in for a battery of four boilers, two of which are now in place. The boilers are multi-tubular, 20 feet by 7 feet with 4 inch tubes and will sustain a steam pressure of 120 pounds. They are fired below, the gases returning through the tubes. The stack is 110 feet high and five feet eight inches in diameter. It is built of one-quarter inch steel plates which after being well painted on the inside was lined with brick. At the top an annular cap prevents moisture getting between the lining and steel shell.

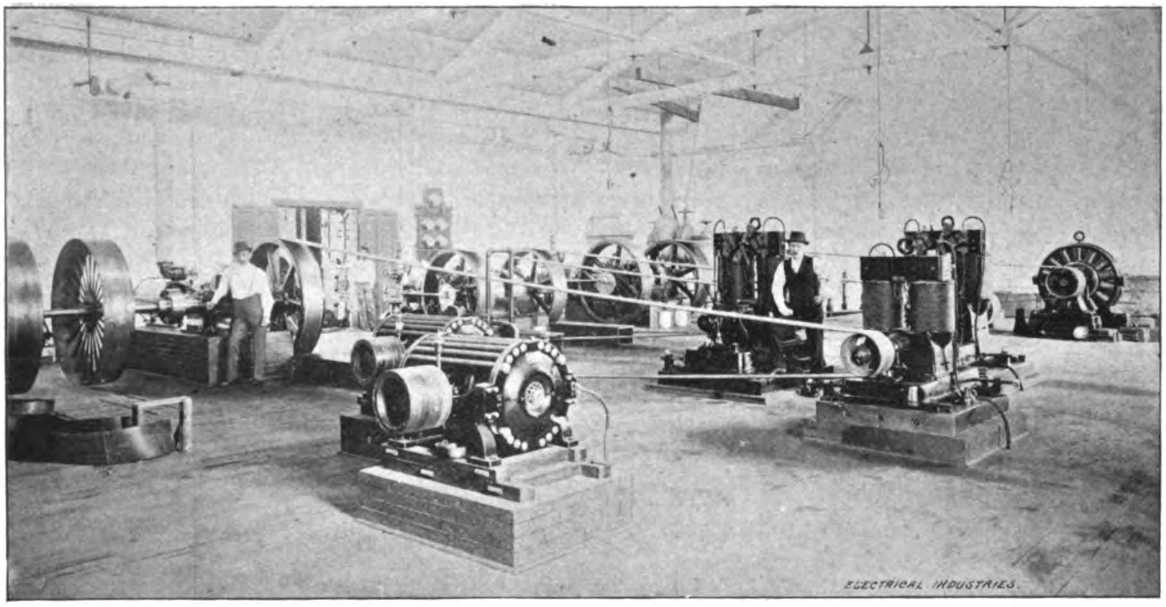

FIG. 2 —ELECTRIC LIGHTING IN HONOLULU.

The steam pipes and fittings are of a size sufficient for the entire battery of boilers. The steam pipe enters the engine room and by a tee leads each way, being reduced in size as branches lead off to the different engines. There are now installed in the station one 200 horse-power cross compound condensing Ball engine, one 150 horse-power cross compound condensing Ball engine and one 100 horse-power Armington and Sims single engine. These capacities are for the engines running non-condensing. The exhaust pipes are so arranged that the change may be made in a very few minutes from condensing to non-condensing, or vice versa. In which ever way the engines are run all the exhaust steam passes through a counter current feed water heater before reaching the condenser or being exhausted into the air. The condenser is of the shower type and takes its injection water from a series of five 10-inch artesian wells drilled in a corner of the engine room close to the condenser and air pump. The air pump is an ordinary Blake direct acting vacuum pump with 14-inch steam cylinder, 18-inch air cylinder and 24-inch stroke. To drain the exhaust pipes and the bottom of feed water heater a small Blake service pump is used.

The water supplied by the artesian wells is always fresh and is intended to be used in the boilers should the supply of city water at any time fail. The electrical generators now in use consist of one self-regulating T-H alternator of 2,000 16-candle power lamp capactiy, two Edison dynamo of 750 light capacity each, one Edison 30-horse power generator and one T-H 15-horse power generator, making the total capacity of the station 4250 16-candle power lamps, while the number of lamps on the circuits, many of which are used only at times, is greatly in excess of that number. Negotiations are now being carried on for the transfer of the commercial lighting now done by the government to this company which would increase the plant more than a thousand lights.

As there is no gas to compete with, a large number of lights are furnished to residences, a majority of which are within a radius of two miles of the station. Lights within three quarters of a mile are supplied by the Edison three-wire system, while those at a greater distance are supplied from the alternating current circuits. A considerable current is furnished for power for various purposes during the day. A rate of 25 cents per kilowatt hour by meter is made for both lighting and power which is subject to a scale of discounts. Australian coal is used which costs about $7.50 per long ton. The station is supplied with everything necessary to the economical generation of electricity. The installation of the plant has been accomplished in a skillful and substantial manner under the supervision of Mr. W. I. Warriner, the superintendent of the company. The steam plant was furnished by the Honolulu Iron Works Company. The electrical equipment was installed by Messrs. E. O. Hall & Son.

The process of electro galvanizing wrought iron plates is said to cost about one-half that of the ordinary process of galvanizing. The advantages of the process also appear in the better plates produced. The tensile strength is not reduced nor are the articles warped or distorted.

Electric Power in Taftville Cotton Mill.

The advantages of electricity for power transmission is shown by the number of recent installations and especially in utilizing water powers at some distance from the factory. At Taftville, Conn., are located some important cotton mills using the power of the Shetugket river. In the mills of Mr. E. P. Taft at Baltic and Taftville, the valuable water rights of the river have been developed, and by an electric plant the power is distributed to the mills, replacing two 350-horse power engines.

In Fig. 1 are shown the relative positions of the generating station at Baltic and the receiving station at Taftville. The line is nearly four and one-half miles in length and is carried along the highway up the river, skirting its banks in places and crossing it at intervals to shorten its route. In the basement of this building are the wheel and dynamo rooms of the generating plant. Four hundred feet above the mill a dam 525 feet long has been thrown across the river. The effective head on the turbines is 32 feet and the water available, even in the driest seasons, is sufficient to furnish not less than 1,500-horse power. The turbines are belted to pulleys on the main line shaft, extending the whole length of the wheel room and continuing through the partition walls into and along one side of the generator room. The pulleys are thrown into, or out of, action by Hunter clutches mounted with pulleys on quills, so that any or all of the wheels can be applied to driving the shafts. Similar pulleys and clutches are furnished in the dynamo rooms for throwing in or out the various machines that may there be placed.

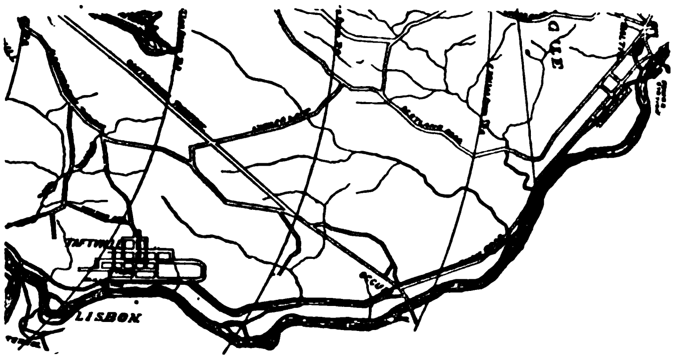

FIG 1.—ELECTRIC POWER IN TAFTVILLE COTTON MILL.

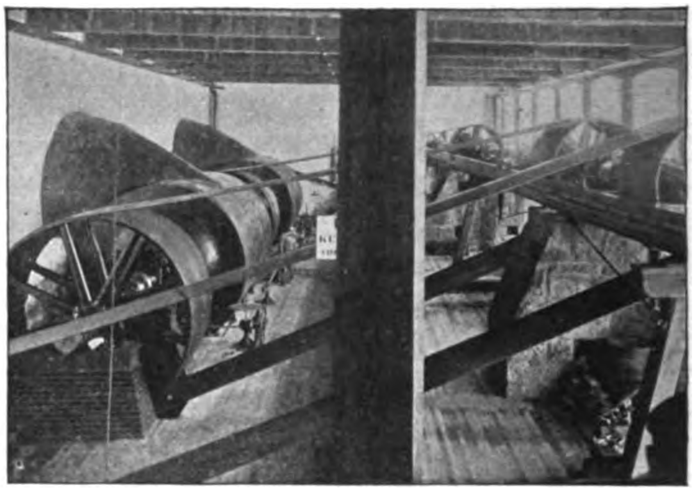

FIG. 2.—ELECTRIC POWER IN TAFTVILLE COTTON MILL.

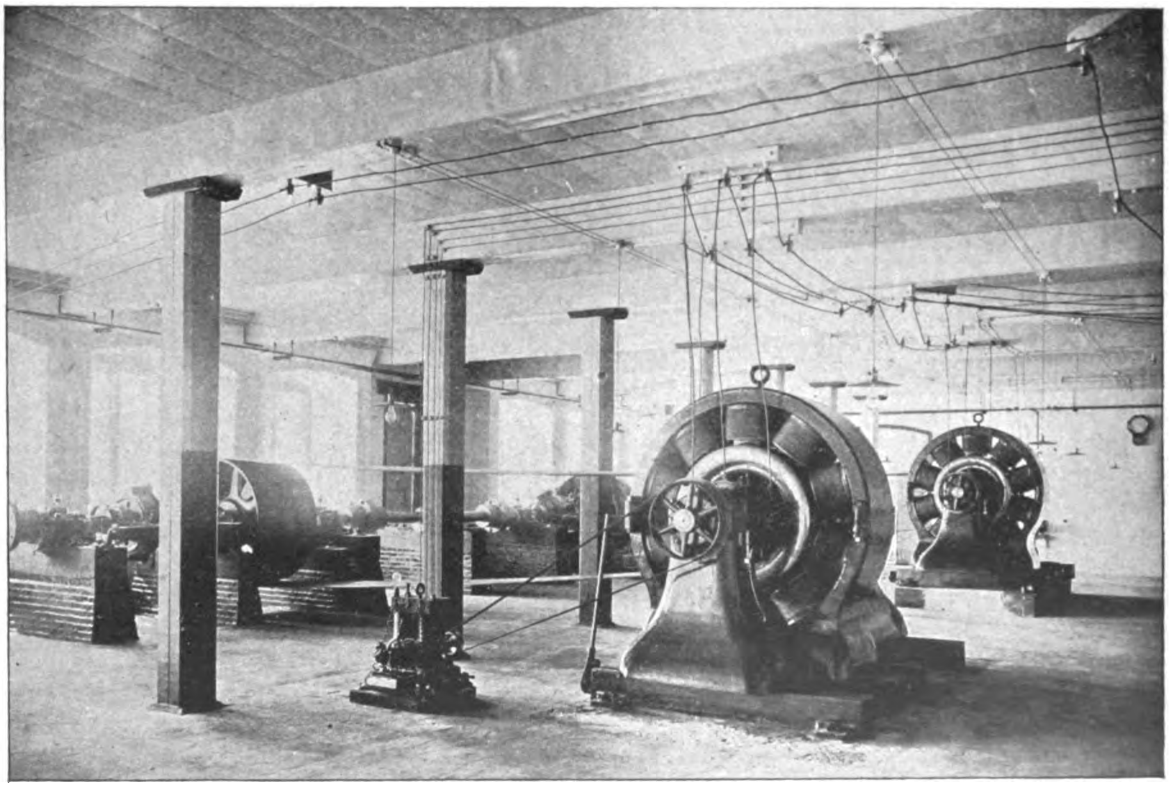

FIG. 3.—ELECTRIC POWER IN TAFTVILLE COTTON MILL.

Fig. 2 shows the wheel room and the arrangement of the turbines and line shaft. There are three double 42-inch horizontal wheels and one double 27-inch wheel, the former developing 800 effective horse power, at 157 revolutions per minute, and the latter 300 horse power at 244 revolutions per minute. The belts pass obliquely upward to the pulleys on the line shaft, and the turbines are kept at speed by Schenck electric governors, which have proved themselves capable of doing very fair service. The wheel plant and shafting were made and installed by the P. C. Home Company, of Gardiner, Maine. The line shafting is supported by heavy iron girders set on stone piers and additionally braced by timbers. The dynamo room, beside the shafting, is occupied by two 250 K. W. General Electric three-phase generators, delivering current to the line at 2,500 volts. Each machine is provided with its own exciter, a 3 K. W. bipolar dynamo. The three-phase machines run at 600 revolutions per minute, and are set so firmly on substantial foundations as to run with scarcely a perceptible vibration. The driving pulleys on the main shaft are fitted with Hunter clutches, so that either machine can be dropped out without the slightest disturbance to the service. The line, a characteristic bit of which is shown in Fig. 4, is a good piece of construction work on substantial wooden poles placed 100 feet apart. The upper wires on the cross arms are of No. 0 bare copper and form the original three-phase circuit designed for the transmission. The wires on the lower cross arm are No. 0000 insulated wire, and are four in number. They were originally intended for a railway circuit, the generators for which were to be installed at Baltic to feed the Norwich Street Railway; but as the amount of copper necessary to do the work successfully appeared too great, the system was changed, a second three-phase generator and motor were added, and three of the four proposed feeder wires were utilized for the three-phase circuit. All are supported on the General Electric Company's standard insulator, the fourth No. 0000 wire forming a convenient relay in case of accident to any of the others.

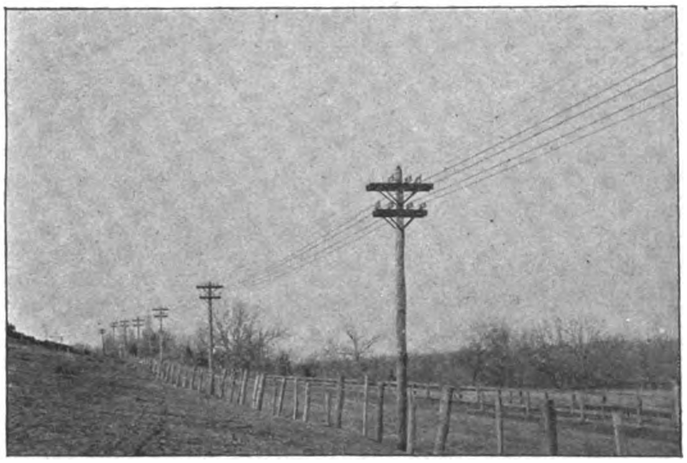

FIG. 4.—ELECTRIC POWER IN TAFTVILLE COTTON MILL.

At Taftville the three-phase circuits are led into the basement of the new mill, where they drive two three-phase synchronous self-starting motors, identical in size with the generators at Baltic. These machines replace the two Corliss engines previously used. These motors are belted to the jack shafting previously driven by the engine, the pulleys on the shaft being equipped with friction clutches so that the load can be thrown from engine to motor, or back again, without any interruption of service. The motors start entirely unaided, coming up to synchronous speed in about fifty seconds from the time the current is thrown on. They are, like the generators, separately excited, the exciters being driven from the pulleys on the end of the motor shaft.

The efficiency of the complete transmission at full load, from the power applied to the dynamo pulley to that delivered to the motor pulley, is 80 per cent. In originally starting the mill before the second motor was ready for operation, it was the custom to bring the motor up to speed, and then gradually throw in the clutch connecting it to the shafting already running from one of the engines. When the clutch was fully in and engine and motor running together, the engine was disconnected by its clutch and the power transferred entirely to the motor. This could be done without producing the slightest disturbance in the speed, and in the same way, now that both motors are in and the engines shut down, the load can be shifted from one motor to the other if desirable. Ordinarily, however, there is work enough for both, when driving the 1,700 looms in the new mill, operating the lighting plant and the three 80-horse power General Electric railway generators, installed in another part of the basement.

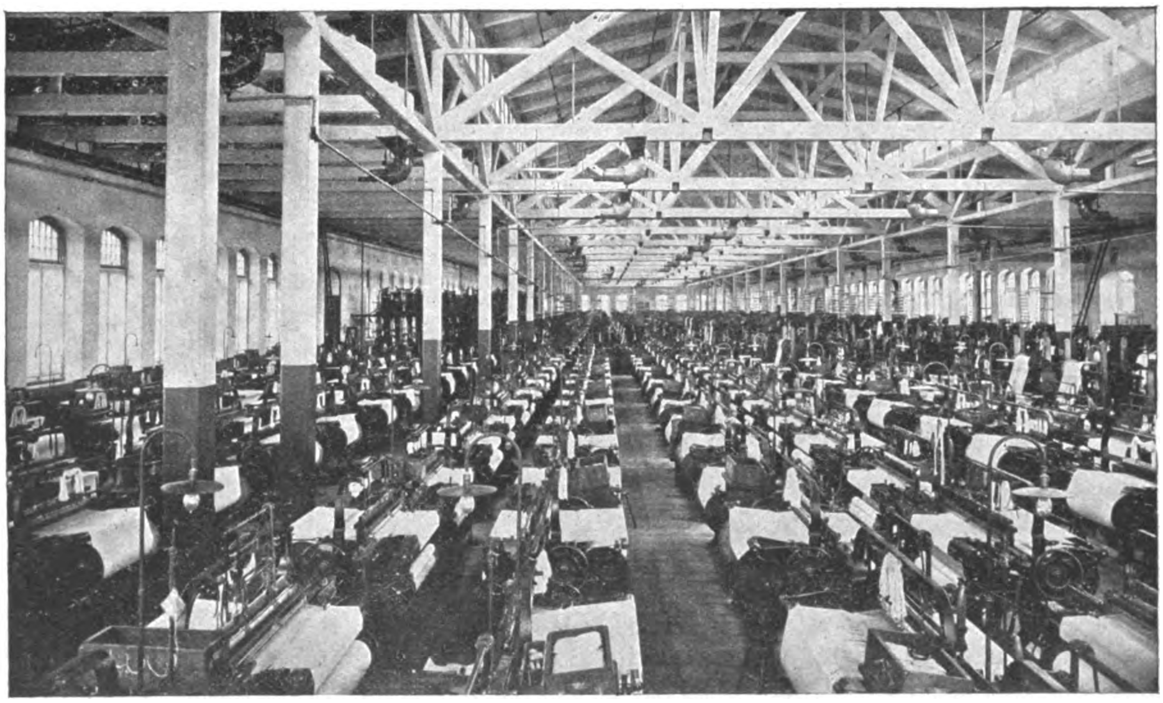

FIG. 5.—ELECTRIC POWER IN TAFTVILLE COTTON MILL.

Fig. 5 shows the upper weave room of the new mill driven by these motors, and gives some idea of the work done by the motors and the extensive operations of the mill. This weave room is occupied at present in the production of delicate, plain cotton goods for printing; the Jacquard looms for fancy goods being located on the floor below.

Jules Verne, Pennock, and Now Cutter.

BY THOS. G. GRIER.

Jules Verne had an imagination which flowed untrammeled in the channels of unexplored science; for to him to wish and to create were identical. Through the legitimate paths of literature he gently extracted the nimble dollars from the willing public.

Once upon a time there lived within the boundaries of populous Cook County, Ill., a person whose surname was Pennock. Pennock, "the artful," also lured the unsuspecting to his feast, where he, unlike his predecessor, creator of the impossible, was alone the diner.

This individual who waxed and grew fat in the great city of Chicago, had a primary battery that could run street cars, electric lights, motors and what not, and who also had stock for sale, was plausible, suave, and told a story most agreeably to those who desired sudden wealth. Note carefully it was a primary battery and it would revolutionize the world. There has been other exploiters of the primary battery, but none have had the audacity and push that marked this Napoleon of electrical science. His literature has permeated to the farthermost ends of the civilized earth and many are those, who with the ignorance and faith of children, stand ready to cast their money into the bottomless bag, if anyone would give them the slightest encouragement.

George Cutter, the well-known engineer, a man whose reputation as a scientist is recognized in this and foreign countries, has been contributing to the columns of the press vagaries of a wandering fancy called "What I Don't Know About Electricity." In his latest effusion he claims as his hobby "The developing of primary batteries," "batteries that will be useful in residence lighting at a cost that will not be prohibitive." "It is a promising field to work in." Pennock, the great, and others of less calibre have found the field not only rich in promise but rich in reward. With words of wisdom from the pen of a man recognized among the savants in the electrical field as a worker and brother, the primary battery pasture will blossom afresh, revived by the fertilizing words of a wise man's illusions.

Mr. Cutter's fluent pen should wander to the realms of fiction where the reputation of his name could be hid under the cloak of a *non de plume*. The field of prophecy is an open one, yet it is not well to let the reputation so well earned suffer for the sake of visions of the future. Mr. Cutter may be several decades ahead of the time, but to travel ahead of the army of workers in the field of science, does not harmonize with the true economy of the profession.

However, when Mr. Cutter gets far enough along to sell stock in his primary battery he will no doubt be able to find a few able promotors who have had years of experience in floating primary battery stock; he may also be able to buy a few second-hand stock books. The great and saving line in his paper in which he has given his strong support to the primary batteries is "What I don't know about Electricity" and thus have I advisedly called it the visions of a wise man, and the vagaries of a wandering fancy.

Paul Jablochkoff.

Paul Jablochkoff, who possessed a world-wide reputation as an inventor, died on April 5, at Saratoff, Russia. He was born in Saratow, Russia, September 14, 1847, and was therefore in his 47th year. He received as good an education as his country affords, first in the Military Engineering College at St. Petersburg, then at the Military Galvano Technical School. In 1871 he was appointed director-general of the Moscow-Koursk telegraph lines. He had early shown an aptitude in the study of electricity and continued the study of electricity during the time he was in charge of the telegraph. In 1876 he went to Paris, where he devoted himself to the study of arc lighting. His experiments resulted in the production of the Jablochkoff candle. A company was formed to manufacture the apparatus and introduce the system of lighting.

In May, 1878, The Avenue de l'Opera, Paris, was lighted by these electric "candles." What seemed a great success in the use of electricity for illumination made his name famous immediately the world over. The adoption of the Jablochkoff candle in Paris led to its use in other cities. The modern arc lamp, however, soon displaced it, so that the period of its success was brief. Many other inventions for which patents were taken out, and investigations and experiments in electricity made his name almost as famous as the invention of the method of electric lighting. He spent a considerable time in the study of alternating currents with success. During recent years his work has attracted little attention.

The Annual Meeting of the American Street Railway Association.

The following list of committees and subjects on which they will report has just been announced by the executive committee for the thirteenth annual meeting of the American Street Railway Association, to be held at Atlanta, Ga., October 17th, 18th and 19th, 1894:

"Can the T Rail be Satisfactorily Used in Paved Streets?" Joel Hurt, Pres. Atlantic Consolidated St. Ry. Co., Atlanta, Ga.; S. Hendrie, Manager, Wyandotte & Detroit River Ry. Co., Detroit, Mich.; H. J. Crowley, Engineer, Atlanta Consolidated Street Ry. Co., Atlanta.

"City and Suburban Electric Railways." Elwin C. Foster, Supt., Lynn and Boston R. R., Boston, Mass.

"Mail, Express and Freight Service on Street Railway Cars." Richard McCulloch, Elec. Engr. Citizens' Railway Co., St. Louis, Mo.

"The Best Method of Treating Accidents and Complaints." John B. Parsons, Genl. Mangr. West Chicago Street R. R., Chicago.

"Street Car Wheels and Axels." D. S. Cook, Elec. Engr. Trenton Pass. Ry. Co., Trenton, N. J.

"Transfers and Commutation." Rodney Curtis, Pres. Denver Tramway Co., Denver, Col.

"The T Rail Construction of the Terre Haute Street Railway Co." M. F. Burke, Supt. Terre Haute Street Railway.

"A Standard Form for Accounts for Street Railways." H. I. Bettis, Cons. Engr. Atlanta Cons. St. Ry. Co., Atlanta, Ga.

Accommodations for the convention, as previously announced, have been secured. The exposition building in Piedmont Park has been engaged for the exhibition of street railway apparatus, and the meetings will be held in the auditorium in the same building.

ODDS AND ENDS.

There are 100 students taking the course of electrical engineering at the University of Michigan, Ann Arbor.

The proposed pan-American telegraph line to connect by the telegraph the countries of South America with those of North America is being rapidly pushed by the promotors who are now negotiating for franchises through the states of Central America. This line when it is completed, whether by this company or some other, will give a much more direct communication than that at present employed.

According to the U. S. census the average cost of steam power is $36 per horse power per year, or for a total of 3,130-horse power hours. Water power costs 23 cents against 1.15 cents for steam power per horse power hour. At Niagara Falls it is said that power is being contracted for at from $8 to $20 per horse power per year under terms that allow the use of the power 24 hours a day for the 365 days in the year.

The success of the system of marking channels by electric lighted buoys as used at Sandy Hook and in Lake Michigan during the World's Fair will probably lead to the establishment of many similar systems. Capt. W. S. Schley, U. S. N., and Lieut. Commander C. H. West, U. S. N., of the United States Lighthouse Establishment, recently visited Mobile, Alabama, for the purpose of considering the advisability of lighting the dredged channel through Mobile Bay by such a system.

At Paris, France, an international electrical exhibition is to be held from July 1st until October 1st, 1895. It is expected that the exhibit will be large and will be composed of the products of the best engineers of the different countries. The generating station will be located in the Palais des Machins at the Champs du Mars and the main exhibit in the Palais du Industries at the Champs Elysées. Being devoted entirely to electricity it is expected that it will bring together many noted engineers and scientific men.

A suit, new to Canadian courts, has been entered by the Bell Telephone Company of Canada, against the Montreal Street Railway Co., for $27,000 damages, the cost of putting return wires on the telephone system. The telephone company states that the introduction of the trolley system has necessitated this change and that having enjoyed the use of the ground as a return from the time of the establishment of the telephone system the railway company should reimburse them for the expense of making the change.

The Faraday is now engaged in laying the new cable of the Commercial Cable Co., from Ireland to Nova Scotia. The shore sections are being laid first, 100 miles off the coast of Ireland and 400 miles off the coast of Nova Scotia. The remaining 1,500 miles will then be laid. This new cable, which is the third trans-Atlantic cable owned by this company, is guaranteed to give a speed one-third greater than the cables now used by the company. A speed of 30 words per minute will thus be obtained. The cable is the largest ocean cable so far laid.

"Electricity, magnetism, terrestrial attraction," Rev. J. A. Dewey holds, in writing on the "Nature of Electricity," to be "merely one and the same power acting with different forms and kinds of intensity. That power is generated by the action and reaction of material atoms one upon the other. It increases in intensity according as the superfices of the atoms are so placed that their centers can enter into the closest proximity, thus producing the three different grades of ordinary attraction, magnetism and electricity. The reason why the centers of the atoms—or, to speak more correctly, the atoms themselves—are thus spontaneously drawn toward each other is to be found in the fact, which is being daily proved to be more and more universal, that each atom is animated by a principle of life and feeling. This alone in the whole range of nature is found to be a spontaneous cause of motion. A rudimentary life there must be attached to every atom, however small; from the highest to the lowest organism there is present life, which, indeed, gradually diminishes so as to become imperceptible in its manifestations, but never does it become altogether extinct."

Under the heading "Small Arc Lamps" in the Electrical Engineer of March 28th, Prof. Elihu Thomson describes some of his early experiments with the electric arc. "Very small arcs," he says, "have a woeful tendency to rotation, a motion of the arc which has a very disagreeable effect on the character of the lighting and practically destroys its utility. The rotation seemed to be regularly performed by the arc in the crater of the positive carbon, casting the main body of light in a rotary manner or a constantly changing direction. With a good quality of carbons, arcs using from 160 to 200 watts are perfectly practicable even with the ordinary mechanism for feeding the carbons." The growing appreciation by station men and others of the fact that the best results in arc lighting are dependent upon the use of the finer varieties of carbon instead of the cheaper poor articles, is gratifying. Fair carbons were a rarity from 1879 to 1883 and the difficulties then encountered can scarcely be appreciated by those who enter arc work at the present time. "It does not appear that the introduction of small arcs should have any serious effect on the use of incandescents in their legitimate field. It ought, indeed, in many instances to have an opposite effect in somewhat the same way that the introduction of arc lights often led to increased gas consumption, as the standard of sufficiency in illuminating created a demand for more light."

There is an impression that if a machine will run steadily in one place it will run just as well anywhere, when in reality the very foundation has a good deal to do with it. Not long since two men were setting up a light machine that gave no trouble where it had been at work for the last year or so, but when the speed was started set up a discord that made the very floor the machine sat upon play the part of a sounding board. Some suggested that the men take hold of the machine and hold it out bodily with their hands, not allowing the machine to rest anywhere. It ran so smoothly and quietly that it was suspended from the floor beams overhead by rods, and is now running in that way to keep peace in the establishment. In several cases where high-speed engines have made trouble in this respect, a platform for the engine to rest upon, suspended by rods and cross ties from the framework above, has confined all the disturbance to the engine itself. It is not an uncommon occurrence to find an engine, when first erected on a firm foundation, set up a jar that does not feel right until it has loosened up the settings somewhere to give it this vibratory elbow room. However, when a machine sets so badly that it must be suspended by guy rods to give it a chance to shake without shaking down the whole building, it is time that the machine itself should be looked into and something done to bring it in harmony with the floor on it is to set upon.—Journal of Commerce.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

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The editors as well as the entire constituency of Electrical Industries will be very grateful if every reader will send in or call attention to any occurences he may think will interest others. If there is a new enterprise or a new application of electricity that comes under your notice, please let us know about it. If you have an idea or there is anything connected with your plant upon which you would like information or that you think would interest any of your friends let us hear from you. It is a pleasure at all times to answer questions. Photographs or drawings to enable us to make an illustration are always appreciated. In fact let every reader of this journal take a personal interest in sending on an item and in that way the value of the paper to everyone will be increased many fold.

Something of the appreciation by both subscribers and advertisers of our recent departure in publishing in separate form the directories which have heretofore formed a part of each issue of Electrical Industries, is shown in the many communications received from every part of the country, a few of which we publish on another page of this issue. The scope and convenient size of the new publication seems to especially please the trade and for the many kind words of approval we return our hearty thanks. This directory as announced last month will be published quarterly and will contain complete directories of the Electric Lighting Central Stations, Electric Railways, and, as soon as completed, a directory of the Isolated Electric Light and Power plants. Our facilities for securing correct information regarding the various electrical installations in this country now in service and contemplated, have increased year by year and are now unexcelled. The information received will be published in the regular issues of Electrical Industries while the directories will be entirely revised each issue before going to press, making them both accurate and reliable.

Electricity as used in the illumination of the grounds and buildings and in the many styles of decorative lighting forms one of the great attractions of the California Midwinter Fair. The work that has been done in this direction although aided by the experience at the Columbian Exposition is remarkable. The engravings in this issue give but a faint idea of the lighting effects. The colors and the constant changing of the designs, some instantaneous, others gradually fading out and others growing in, it is impossible for photography in the present state of the art to reproduce. In the face of a strong and discouraging opposition and during a season of business depression, the worst for many years, it is wonderful what has been accomplished on the Pacific coast. The history of the construction reminds one of pioneer tales but the struggle is entirely concealed in the success of the undertaking.

Mayor John P. Hopkins and the city council seem to have come to an understanding regarding the ordinances giving to the North and West Chicago street railway companies the right to operate their cars by the overhead trolley system. The subject has been before the city officials for some months, the mayor endeavoring to secure the lighting of the streets on which electricity is to be used while the aldermen could not see the justice of it. The amended ordinance, which was placed before the council by the mayor on April 30th and passed by the council, while it does not provide for the lighting of the streets on which the trolley is used, provided for the payment of certain sums of money "to be used by the city of Chicago for extending its electric lighting system." These sums are as follows: At the expiration of the first year, jointly by the North and West Chicago St. Ry. Co.'s, the sum of $10,000; at the expiration of the second year after the the passage of the ordinance the sum of $15,000; at the end of the third year, $20,000, and at the end of the fourth year and each succeeding year the sum of $25,000. The ordinance also requires the payment within 30 days after the passage of the ordinance of sums aggregating over $30,000, being the amount of land damages secured from the city in the construction of the Dearborn street bridge and viaduct. This is the value in the minds of the city officials of the privilege of operating street cars by the overhead trolley system in the portions of the city not thickly populated—$25,000 per year, four years being considered necessary to complete the substitution of the electric system, or in other words the companies must pay to the city each day of the 365 days in a year the fares of 1,400 passengers. In addition also to this the railways must carry free of charge the policemen and firemen of the city. This decision was undoubtedly influenced by the fact that the companies hold valuable franchises from the city for which no adequate compensation is received, and it would be very interesting to know how this valuation was arrived at.

Seldom does an annual report show so large a shrinkage of net assets as the second annual report of the General Electric Company, which was submitted at the annual meeting of the company last month. The affairs of the company were, however, so well known, that it caused no surprise, and had little effect on the price of the stock. The cause of this apparent shrinkage is attributed to the overvaluation of much of the company's assets in the report of a year ago, and the financial depression, which not only caused a shrinkage in the value of the stocks and bonds held by the company, but also of the goods on hand, and in process of manufacture. In rating the value of the securities held, the report shows a more conservative estimate, but the item of $8,159,264.04, patents and franchises, stands up like a shadow which gradually fades away as the light approaches. It is true that many patents have been and are of immense benefit to their owners, securing either a monopoly of the market by the exclusion of others, or by a cheaper method of production has enabled them to drive others from the field. In the case of the General Electric Company this is not a fact; its patents have neither given it a monopoly of the field, nor has it been able by lower prices to secure a monopoly, while in the 20 months since its organization, immense sums have been spent in litigation. It is a question whether the company has derived as much benefit from its patents as it has spent in defending them. According to the Boston News Bureau the cost of patent litigation in this country has amounted to $500,000 per year for several years, and the General Electric Company is one of the large contributors to this amount. The incandescent lamp patent has not secured the field, for at least three independent companies are now manufacturing incandescent lamps at the rate of many thousand a day. Electrical installation of every kind are made by competing companies who suffer no inconvenience on account of the systems controlled by the General company. The changes made in conducting the affairs of the company is one of the important items noted in the report. The concentration at Schenectady of the management of the company, the abolition of the district offices, and the establishment in their places of sales offices, are the principal changes. As marked out, future sales are to be made for cash or short credit to desirable parties only, thus materially changing the former policy of the company. Should this be continued,and the promotion of local companies be abolished, it will not again carry such a large amount of unlisted securities, the sale of which is difficult except at a heavy discount. The lessons learned during the past year will undoubtedly be of assistance in conducting the future affairs of the chmpany. It is reported that the capital stock of the company is to be reduced in order to enable the company to resume the payment of dividends. It is not probable that the effect of last year's business can be repaired. The prices formerly received for electrical equipments may never again be secured. The fact that incandescent lamps which a short time ago sold for 65 cents can now be purchased for less than 30, illustrates this point. Other apparatus shows a decrease nearly as great. When customers have once purchased goods at a certain price, it is most difficult to obtain more from them, so that it is not probable that prices and profits in electrical apparatus will in the future approach those of a few years ago.

A decision is just rendered as we go to press in the case of the Electric Manufacturing Co., of Oconto, Wis., vs. The Edison Electric Light Company and The Edison General Electric Light Co. A preliminary injunction was granted by Judge Seamans last fall restraining the first-named company from the manufacture of incandescent lamps. On the appeal tried in the United States Court of Appeals, the seventh judicial circuit, before Circuit Judges Woods and Jenkins and District Judge Bunn, the order appealed from is affirmed. The defense in this suit was that now well known as the "Goebel defense" regarding which Judge Jenkins says:

> Mr. Goebel claims to have made this discovery a quarter of a century before, in the year 1854, in New York, and to have made these incandescent electric lights for his own pleasure and amusement, and to have used them for lighting his store and to light a wagon upon which was mounted a telescope with which he publicly traversed the streets of that city. As this record is now presented to us, and considering the claim in the light of contemporaneous history, we find it difficult to give credence to the story. During a quarter of a century, from 1854 to 1880, the scientific world was struggling with the problem and could not solve it; and yet, if the claim asserted for Mr. Goebel be well founded, it had already been solved, and he had made public demonstration of it in the commercial metropolis of the Union, the scientific world, however, and the public generally remaining in total ignorance of it. The mind cannot readily yield assent to the assertion of a claim under such circumstances, and when it is supported solely by ex parte evidence.

Method of Balancing the Three-Wire System at Burnley.

The supply from the Burnley Corporation Central Supply Station began during the latter half of 1893, and has been continued satisfactorily up to the present time. The system in use is the low tension three-wire, distributed from a point in the center of the town. The generating station is situated a quarter of a mile from the distributing box, and close to the river Calder, from which a good supply of water for boilers and condensers is obtained.

At present there are two 180 horse-power horizontal compound and condensing engines laid down, built by the Burnley Iron Works Company. Two Elwell Parker dynamos manufactured by the Electric Construction Corporation are also fixed, and have an output of 400 ampères at 230 volts. But the most interesting feature in the installation, perhaps, is the method adopted for balancing the current in the three wires with only one machine running. The dynamos are connected across the two outside wires of the three wire system run in parallel, and the balancing is accomplished by a continuous current tranformer assisted by accumulators.

This "compensator" is similar in construction to the high-tension continuous current transformer of the Electric Construction Corporation, weighs about two tons, and absorbs only five or six B. T. units per day in performing its duty. It has two armature coils wound on one drum, and each capable of giving 200 ampères at 110 volts. These two armature coils are connected in series across the outside mains, the middle main of the system being joined at the point where the two armatures are connected together.

Now, if one side of the three-wire system is overloaded, current will pass through the armature on the other side, driving it as a motor, and causing current to be generated in the other armature winding to supply the overload. But it is evident that for the "compensator" to supply current to an overloaded side the E. M. F must be less on that side, or the machine could not supply the required energy, owing to the counter E. M. F. of the armature. It is also found in practice that the resistance of the feeder mains augments this difficulty of working. It is well known that to keep the pressure at the feeding point of a number of lamps constant, on the unequally loaded sides of a three-wire system, it is necessary to maintain the pressure at the generating point, on the overloaded side, several volts higher than that of the less loaded side, to make up for the increased loss of volts due to increased current flow.

If, then, the "compensator" was placed across the mains at the generating station, it would be driven as a motor on the side of highest E. M. F., and that would be the side of the three wires which is most heavily loaded, and therefore would supply current to the side of least load the very reverse of what is desired. In short, the action of the "compensator" depends on the relative E. M. F.'s on each side of the system irrespective of the amount of current that is flowing in the mains. It is found in practice that the required difference in E. M. F. at the terminals of the compensators for various loads is as follows:

With	9	A.	through	generator's	armature	0.0	volts.
"	50	"	"	"	"	1.0	"
"	100	"	"	"	"	1.6	"
"	200	"	"	"	"	3.4	"

This difficulty is overcome by the use of a battery of 120

E. P. S. accumulator cells of the K 31 type. Half of the cells are connected between each armature winding of the compensator and the two outside mains of the three-wire system. There are four battery regulating switches, two for charging and two for discharging. The feeders and the dynamo are connected to the discharging, and the "compensator" to the charging switches. Now, if one side of the system is overloaded, it is only necessary to switch more discharging cells on that side into series with the compensator and the outside main, and to put in a less number of charging cells, thus lowering the back E. M. F. on the armature of the compensator, and permitting it to supply current, and yet increasing the pressure on the overloaded mains in order to overcome the greater drop of potenial.

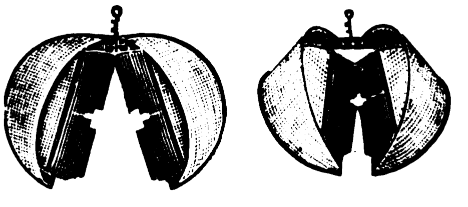
If the other side of the three mains should be overloaded, a similar adjustment must take place on that side. With this arrangement it is never necessary to put more than half the current in the balancing wire through the batteries, and the balancing is done with only one engine and one dynamo running. The battery set is also used for supplying current during the hours of small demand for current, and it has an output of 86 ampères, for nine hours.

The compensator is also serviceable in charging up the batteries, as it will pass current into that half of the battery which is of least E. M. F., tending to make the pressure across the two half batteries equal.

It is at present only necessary to run the station for seven or eight hours each week day, even in winter, the accumulators affording a supply for the remainder of the day, thus necessitating the employment of only one staff of men. The station was constructed under the supervision of Mr. Thomas Parker, M. I. C. E., of Wolverhampton, acting as consulting engineer.—Electricity (London).

The Chicago Spark Arrester.

An easily adjusted and satisfactory spark arrester is shown in the accompanying cut. It is made to fit any arc lamp, whether single or double carbon. It is fastened by an adjustable clamp to the lamp holder inside or out, and is arranged to open out separating in the center so that once in position it is permanently fastened. To trim the carbons it is easily opened on either side, and the globe may also be removed without taking the arrester off. The cover is arranged to open automatically to allow the carbon holder to pass through between the two mica plates. The sides are hinged and close as soon as the holder has passed through. While this takes place the device is so constructed that a draught is established which draws the sparks away from the carbons and the hood is so placed that they cannot escape. These spark arresters are being introduced by the Metropolitan Electric Co., of Chicago.

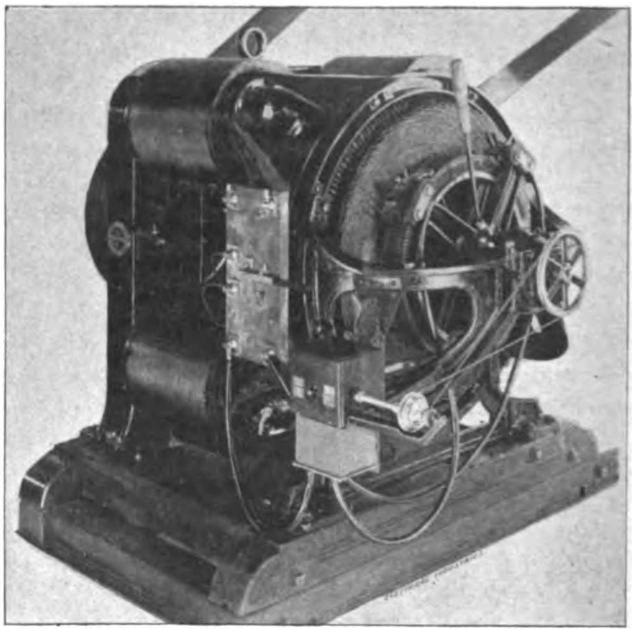


THE CHICAGO SPARK ARRESTER.

Kohler Bros., Monadnock Blk., Chicago, have just secured the agency of the Walker Manufacturing Company, of Cleveland, O., and will handle the entire line of electric railway apparatus the Walker company has recently placed on the market. The territory covered by this agency is western Michigan, western Indiana and northern Illinois, Missouri, Iowa, Wisconsin, Minnesota, Kansas, Nebraska, S. Dakota, N. Dakota, Montana, Wyoming and Colorado.

Western Electric 100-Light Arc Dynamo.

In the accompanying illustration is shown one of the 100 light arc dynamos being constructed by the Western Electric Company of Chicago, for the Municipal lighting plant at Detroit, Mich. The contract, which was recently closed for this plant, calls for 18 100-light arc dynamos. The machine has a very compact appearance for one of its capacity and by inspection it shows a most thorough and careful attention to the details of construction. The poles, of which there are four, are arranged about the armature in the most compact form. The north and south poles are placed alternately. The yoke to which the pole pieces are attached forms the support of the pulley end of the machine. The field coils of which there are also four are wound in series and are included directly in the circuit of the dynamo. The edges of the pole pieces are fastened to the frame which also supports the bearings of the commutator end.



WESTERN ELECTRIC 100-LIGHT ARC DYNAMO.

The armature is of the ring type and is so constructed as to give a large open center, affording an excellent ventilation. The commutator is also large, has air spaces between segments and runs cold without air blast. The brushes used are brass with carbon tips, a style devised by the engineers of the company which has proved very satisfactory. The regulator used is the Western Electric well known type which proves equally reliable in the large machine as in the smaller. The regulation is almost perfect between small load and the full capacity of the machine. The dynamo will furnish current for 100 lamps on a circuit 20 miles in length with a current of 9.6 amperes. Its speed is 500 revolutions per minute.

The bearings, which are of good size, are self oiling and fitted with sight feed guages. The machine shows an efficiency above the exacting conditions of the contract under tests made by disinterested experts. The design is new and each machine will occupy but comparatively a small amount of floor space. The design is such that the dynamos may be operated either by a belt or direction connection. The machines will be completed and ready for shipment as soon as the station is completed.

The New No. 12 Westinghouse Railway Motor.

Something over three years ago the appearance of the Westinghouse single reduction motor marked the beginning of a new period in electric railway traction. Since that time the No. 3 motor with many improvements has been the standard motor and is in successful use on railways in every part of the United States. Some months ago a new motor was announced known as No. 12; this motor had been tried under various conditions of service and is now placed before users of electric railway apparatus. It has been designed by the engineers of the company to meet a demand for a lighter motor and one that has less weight on the car axle. A complete car equipment, new devises of the several kinds having been perfected, is now offered with this motor.

This new motor is made in 20, 25 and 30 horse-power, and for heavier work 40 and 50 horse-power the No. 10 motor is furnished. Still larger motors are also manufactured for elevated railway, mining and other locomotives. The No. 12 motor is a single reduction motor. It is much lighter than the No. 3 motor, the iron frame that supported the motor and in the construction of the motor all metal that would not add to the efficiency or durability of the motor being left off. A change in the winding of the armature has also reduced the weight of copper. The field consists of four pole pieces projecting inwardly from the circular yoke. This yoke is cast in two parts, each containing one half the ends and two pole pieces. On the side opposite the axle the two halves are hinged together so that the lower half may be lowered opening the motor for repairs if necessary. The lower casting has also three openings one just below the commutator and at the opposite ends of the casting. The field coils are much the same as in the No. 3 motor, the capacity being somewhat increased.

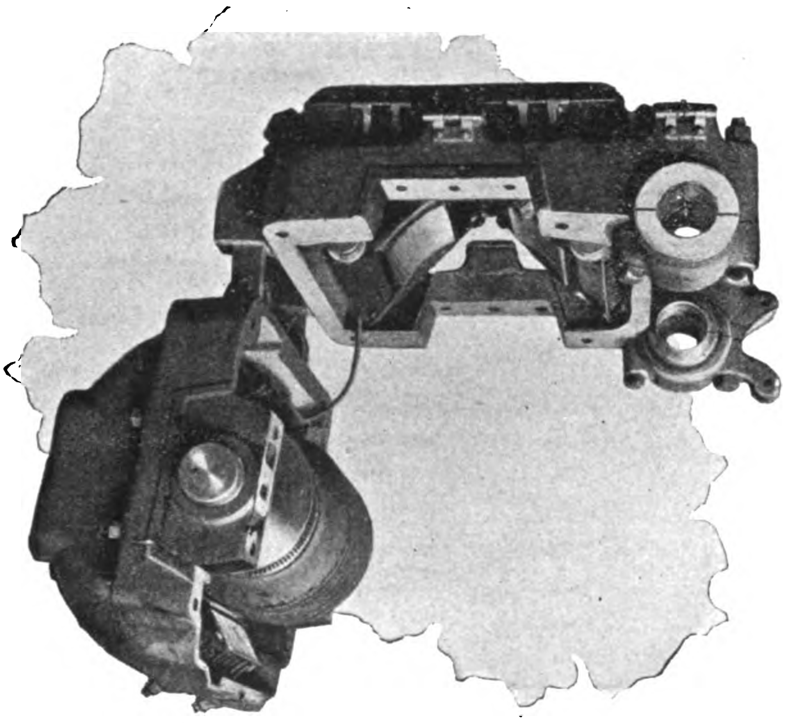


FIG. 1—THE NEW NO. 12 WESTINGHOUSE RAILWAY MOTOR.

The armature is of the drum type, wound with machine made coils. These coils are of a rectangular form, the two longer sides being enclosed in cells of a special insulating material the whole being then wrapped with insulating tape. The coils are connected to the commutator segments so that the armature winding has only two circuits, and requires but two brushes. A high grade of drop forged copper and carefully selected mica insulation are used in the construction of the commutator which is a most important part of every motor. The armature is short and compact and is so protected that oil from the bearings cannot injure the windings. The manner of connecting the winding of the coils of the armature makes but two brushes necessary. These are placed on the upper side of the commutator, 90 degrees apart. The brushes are held in place by a frame which is so designed as to constitute a part of the end of the upper field, and together with a lid, completely incloses the commutator end of the motor. A stiff spring holds the lid tightly closed.

The method of suspending this motor differs materially from that employed with the No. 3 motor. At a point directly above the center of gravity the motor is suspended from a framework resting on four spiral springs, affording a flexibility not attained by previous methods. The axle is relieved practically of all the direct weight of the motor. The motor is free from jars and what is known as hammering of the rail joints is obviated. The construction of the motor and method of suspension gives easy access to any part of the motor. There is nothing of greater importance in the construction of a motor than the provisions made for a rapid and thorough inspection of the fields, armature and bearings. When it is desired to gain access to the whole interior of the motor the car is run over a pit and the lower half of the field opened down either with the armature as shown in Fig. 1 or without it. The armature bushings are carried in blocks which when the motor is closed are secured to both the upper and lower half of field. By removing the bolts holding it to the upper half it will remain with the lower when it is opened and vice versa. The lower half of the field is easily lowered by means of a rope passed over the axle. For all ordinary inspections the openings in the field are sufficient. The large lid above the brushes gives ample room for renewing or inspecting the brushes and the lower openings give access to the under side of the armature.

Among the new apparatus for the equipment of the car the new diverter, No. 7, is of importance. It is designed for use with the new No. 14 controller. The general appearance of the diverter is shown in Fig. 2 and differs but little from the former styles. The resistances are made up of strips of sheet iron placed between strips of mica, the whole being then wound compactly into coils. The coils are enclosed in iron cells which are afterward threaded on an insulating support and built up into short cylinders. Three of these cylinders carefully insulated are supported in a light cast iron box. The terminal block consists of a marble slab carrying four binding posts, to which are connected the wires to the controller. The controller is perfectly fire proof and well ventilated. One diverter constructed in this manner is furnished with each car. It permits the car to start smoothly without jerking and also prevents unnecessary straining of the motors. This motor and car equipment represent the latest ideas in the construction of electric machines and appliances for railway service. Although similar in many respects to the single reduction No. 3 motor so largely used, it is although of lighter weight, slightly more efficient. The Westinghouse Electric and Mfg. Co. has done much advanced work on electric railway apparatus and the present state of the industry is in a considerable measure due to the work of the company in this field.

It is estimated that the cost of operating the plant, recently installed at Rochester, Minn., will be a little less $5,000 per year.

The Harrison Telephone.

The Harrison International Telephone Company owns and controls a large number of patents on the various parts of the telephone system. These patents cover instrument and central exchange devices so that it furnishes and installs the complete exchange system or the private line. The telephones are not sold outright, but are leased at a reasonable rental to individuals or corporations. By this method the parent company pays all cost of defense in suits for infringement. The company also agrees to keep in repair all instruments leased from it, and to replace instruments lost by fire or the elements. The leases are free from restrictions, interference or obligations of any kind except the payment of the royalty agreed upon.

The Harrison telephone is an electric telephone. All parts are simple in construction and are not liable to get out of order. The operation of the telephone is said to be very satisfactory, the sounds being clear and distinct. Exchange systems are equipped either with an automatic telephone switch, which does not require an attendant, or with the manual switch board.

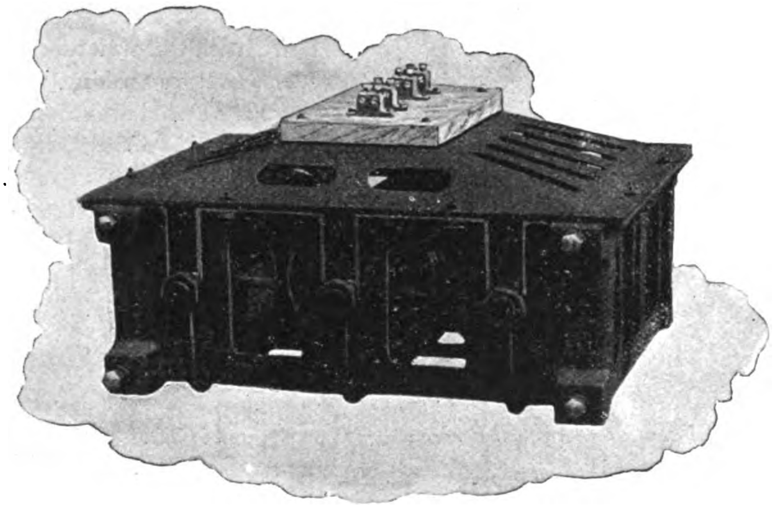


FIG. 2.—THE NEW NO. 12 WESTINGHOUSE RAILWAY MOTOR—THE DIVERTER.

By the use of the automatic switch the expense of the exchange is greatly reduced. The device insures strict privacy in the use of the telephone. On the face of each telephone there is a dial; when it is desired to use the instrument by means of an attachment the pointer is turned to the number desired, and then by pressing a button that telephone is called up. Should that telephone be in use an indicator on the telephone points to "busy." The manual switch is easily operated by an attendant; it is simply constructed and the changes are quickly made. For the use of offices, private lines, etc., special and convenient forms of telephones are manufactured.

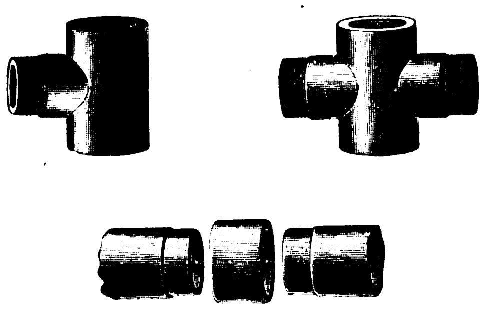
The company has a very strong financial backing if the list of officers and directors are an indication. The officers of the company are president, Stephen B. Elkins; vice-president, C. M. Ferrer; secretary, Patrick Egan; general manager and assistant secretary, H. J. Hanford. Among the directors are R. C. Kerens, of St. Louis; Geo. R. Peck, of Chicago; Robt. P. Porter, of New York; H. M. Holden, of Kansas City and others.

Fibre Conduit.

The Fibre Conduit Company has recently erected and equipped a factory at Orangeburgh, N.Y., for the manufacture of fibre conduit. In its equipment modern practices are everywhere apparent. Electricity is used throughout for the transmission of power and the latest designed electrical machines are used. The shipping facilities are of the best, the company having the advantage of the West Shore, Erie and the Ontario & Western railroads. The main office of the company at 45 Broadway, New York, has just been moved to the Home Life Insurance Bldg., at 257 Broadway, so that the company has every facility for the production and distribution of its goods.

Fibre conduit is used for the protection of underground electric wires and cables. It is manufactured from wood fibre by a machine designed by Prof. Henry Fairbanks and Mr. Howard Parker. After the fibre is made into a tube it is thoroughly saturated with a preserving and insulating compound which produces a hard tough surface. The conduit is made up in five foot lengths and for installing it the necessary fittings are manufactured.

It is tough, elastic and strong. A length of standard three inch conduit will stand a crushing weight between two plain surfaces of 800 pounds per running foot and will sustain at center of a five foot length suspended at both ends 450 pounds. Its weight per running foot is less than one third that of iron. The splitting and checking and the corrosion and disintegration which affect wood and iron is not found in this conduit. Being a non-conductor it is entirely free from the effects of electrolytic action when laid in the ground. It is an insulator for all working voltages. Moisture does not condense on it as on metal nor is it readily affected by acids or alkalies. It will stand exposure to 200 degrees of heat, without weakening.



FIGS. 1-2-3.—FIBRE CONDUIT–CONNECTIONS.

In the accompanying cuts is shown several styles of fittings. Two standard joints are made, one a socket joint and the other a screw joint. A special socket joint is also made which is no larger in circumference than the conduit. The conduit is easily cut at any point with ordinary tools and joints and fittings introduced. This conduit is also used for water pipes, drains, for chemicals or for conveying any liquid. It is believed that the use of this conduit will greatly increase as its qualities are better understood. The demand for all wires to be placed underground and the injurious effects of railway currents on iron conduit will cause a much larger use of this insulating conduit.

American Fuel Economizer.

To utilize more completely the heat of the fuel in the generation of steam and its transformation into power, has been a problem to which engineers have given careful attention. By the use of compound engines the steam is now fully utilized in the production of power. The heat of the exhaust steam has also received attention, and with the present exhaust steam feed water heaters we may look for little advance in that direction. In the construction of boiler furnaces, the introduction of baffle walls, etc., brings the heated air and gases into contact with a large amount of surface of the water chambers. In this direction, while the heat is absorbed by the water in the boiler to a large extent, yet the gases enter the flue carrying with them much of the wealth of the coal.

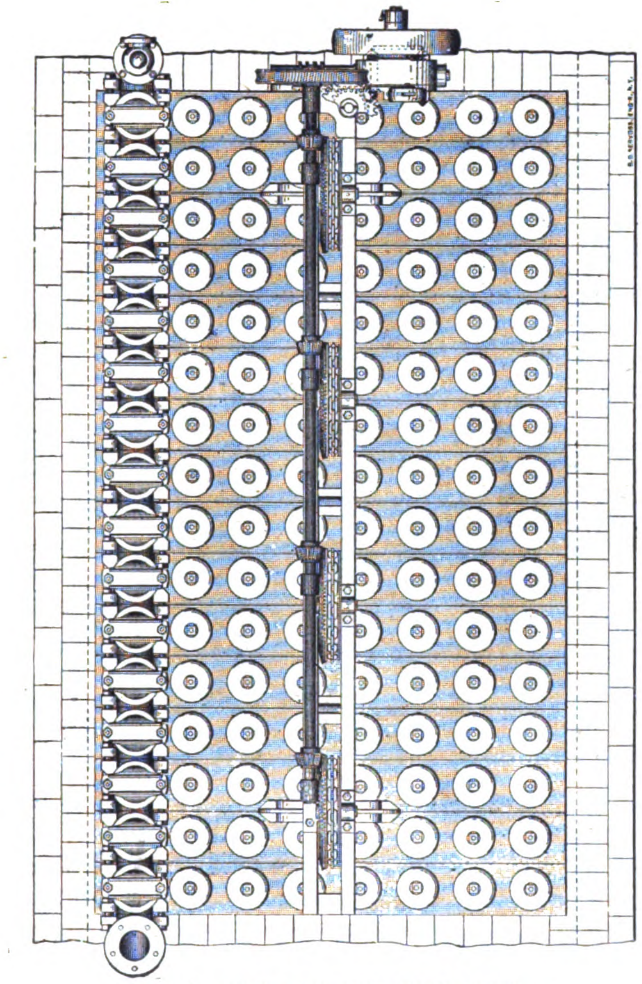


FIG. 1.—AMERICAN FUEL ECONOMIZER.

To utilize the heat of the gases which would otherwise be lost in the air is the province of the fuel economizer. By presenting a large surface to the hot air and gases as they pass through the flue, much of the heat is absorbed by the contained water which is afterwards turned into steam in the boiler. A much larger percentage of the heat of coal is thus utilized in the production of steam. After a careful study of the conditions under which steam is produced, the American Fuel Economizer & Engineering Company placed before the public the economizer shown in detail in the accompanying cuts.

The design of the economizer is such that while it does not obstruct the passage of the gases, it brings them into immediate contact with its surface. Another advantage of this economizer is found in the purified water and the prevention of scale in the boiler. It is estimated that a well-constructed economizer of this design saves from 10 to 20 per cent in the amount of coal consumed. In the construction of the economizer the use of wrought iron or steel has been avoided on account of their corrosion when in contact with water at varying temperatures. In the joints a taper metal to metal joint has been used as the safest and most durable. It presents a strong and symmetrical appearance.

Every part is carefully tested before leaving the works, all sections and pipes to 300 pounds by hydraulic pressure. The manufacturers feel safe, therefore, in their guarantee of the durability of the economizer. In the erection of the economizer substantial foundations are necessary and a thorough construction.

An ingenious method has been devised of cleaning the outsides of the tubes of soot that collects thereon. A set of scrapers supported in a frame held by a chain passing over a pulley on shaft above, are provided for cleaning the tubes. By this method the tubes are easily kept clean and free from anything that will prevent the penetration of the heat. The method of operating this cleaner is shown in Fig. 1, while in Fig. 2 a vertical section of the economizer is shown. The company makes a specialty of the construction of steam and power plants, and the skill in this class of work is shown by the large number of large steam plants installed by the company. The economical generation of steam is a subject well understood by the engineers of the company, and in the construction of steam plants this is carefully looked after. The main office of the company is at 136 Liberty St., New York.

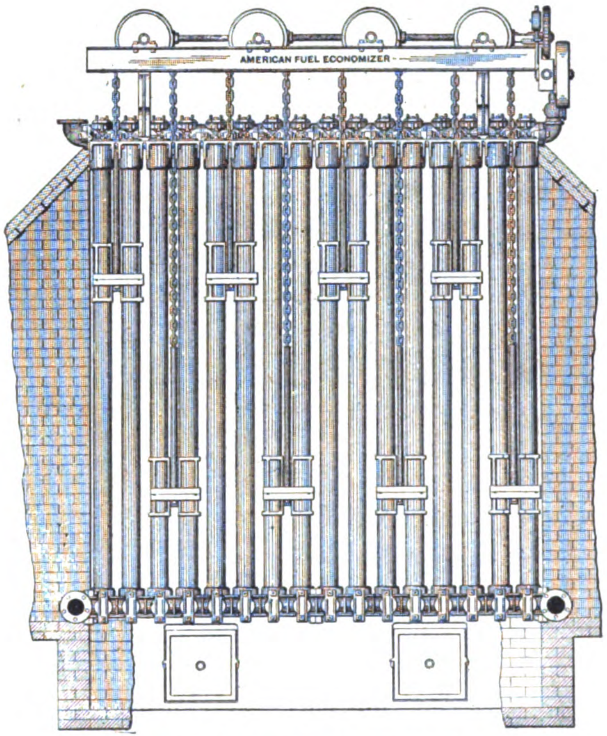


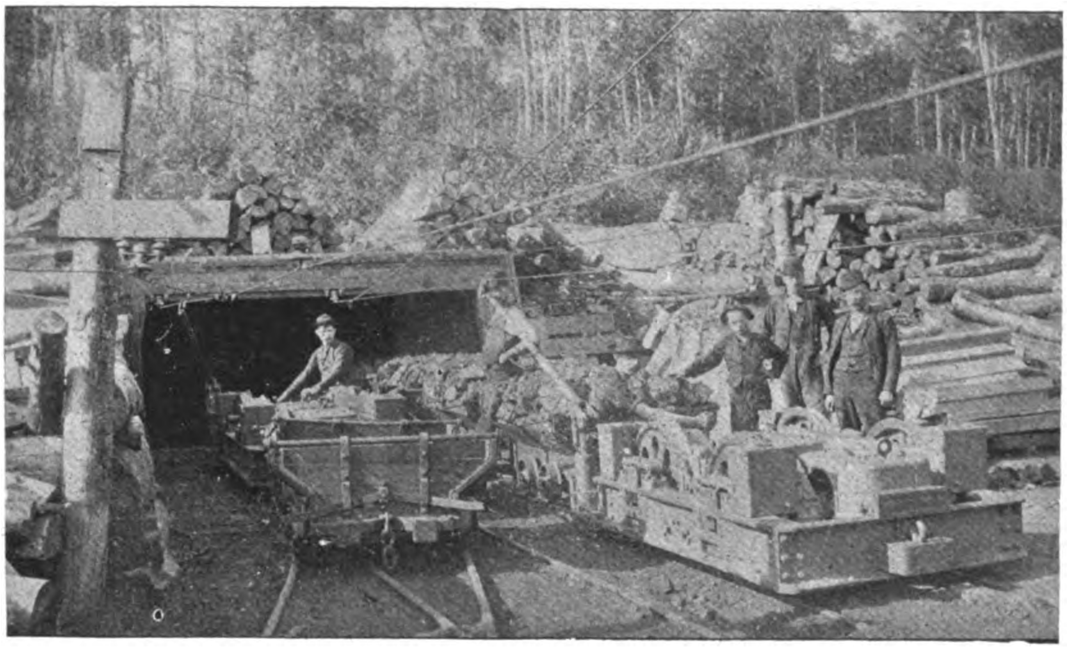
FIG. 2.—AMERICAN FUEL ECONOMIZER.

The Thomson Recording Wattmeter.

In an article on the Thomson Recording Wattmeter for arc circuits printed in our issue of April, It was stated that the safety cut-out "is designed to close immediately on trouble occuring within the meter." This should have read: "The cut-out is designed to close in case of any trouble on the circuit which the meter is measuring. On closing, this device cuts out both the meter and the lamps upon it and serves not only as a protection to the meter but to the lamps which it is measuring. A rise in potential around the lamps, which are being measured, sufficient to cause trouble, will throw this cutout into action and absolutely preclude any danger to the meter or its circuit".

Electric Haulage in the Bear Run Mine.

The practical operation of the electric haulage system in a number of mines has demonstrated its fitness for the service. As the systems of electric traction on the various street railways has confined the use of horses to the smaller and unimportant roads so the electric mine locomotive is driving out the mine mule. The more expeditious and satisfactory service given will extend its use while in many mines in which the veins are narrow it permits a more economical working. The accompanying illustration shows the electric locomotives now used in the Bear Run mine of the Blossburg Coal Co., near Laudius, Tioga county, Pennsylvania.



ELECTRIC HAULAGE IN THE BEAR RUN MINE.

The system was installed by the General Electric Company. The current is furnished by a 75-horse power, D62, power generator driven by an 80-horse power Harrisburg Ideal engine. The locomotives are of the two motor type, with one 30-horse power W. P. motor geared to each axle. The speed is six miles per hour; the draw bar pull 1,500 pounds; gauge 36 inches, wheel base 30 and diameter of wheel 28 inches. The length over all nine feet six inches and width 48 inches while it weighs 7,500 pounds. Current is brought to the motors by a specially designed trolley arm on which the trolley wheel is swivelled to permit of its adjustment to the various irregularities of the trolley wire. The trolley arm can be set in sockets on either side of the locomotive, which may be run into the headings on either side of the main haulage way. Being but 31 inches in height it can enter many places where a mule could not.

These locomotives, it is said, will haul a train of 32 loaded mine wagons weighing 3,200 pounds each over a stretch of track that for a part of the way is on a three per cent grade. The motors and other apparatus is so constructed as to protect it from the dust or dampness of the mines. Every part is made extra strong to withstand the service which it is to perform.

The Wurtz Non-Arcing Railway Lightning Arrester.

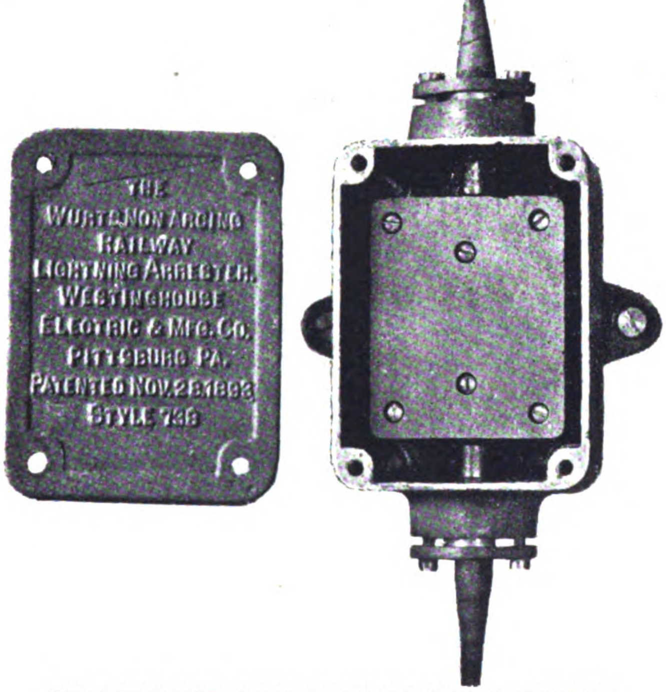
Many devices have been manufactured to protect electrical machines and apparatus from the effects of lightning. Of these devices some have worked satisfactorily in protecting the machines but in doing so the fuses were blown, stopping the plant until they were renewed, while others were themselves rendered useless after one operation. However, with the improvement in every branch of electrical construction new discoveries and greater skill have perfected this important part of the equipment.

The discovery a few years ago of a non-arcing metal, paved the way toward the production of a special form of lightning arrester. A lightning arrester of this kind was first constructed for alternating currents, which has proved most efficient in operation. Mr. Wurtz, after carefully studying the possibilities of such a lightning arrester for direct current circuits, brought out last season a lightning arrester involving the same principles as that for the alternating current. It is designed for use on 500 volt railway circuits. This arrester is one of the standard devices manufactured by the Westinghouse Electric and Manufacturing Co.

The fundamental principles of this device are based on the following facts: 1. That a static discharge will leap over a non-conducting surface, such as glass, wood, marble, &c., more easily than through an equal air space. If a pencil mark be drawn over this non-conducting surface the discharge will take place still more readily. 2. That a dynamo arc in order to be maintained must be fed by the fumes or vapors of its electrodes—conversely, therefore, that in order to avoid the formation of a dynamo arc between electrodes means must be taken to prevent the formation of these conducting fumes.

An electric spark which springs across an air gap does not pass like ordinary moving matter gently pushing the air aside. Its passage is so instantaneous that the air is shattered, so to speak; the spark crashes its way through the air like a bullet through a pane of glass. If, however, the air be previously split electrically split the spark will pass with ease. A pencil mark over ground glass or a charred groove in a wooden surface forms an electrical crack or entering wedge through the air so that an electric discharge finds a much easier path over this surface and through this electrical crack than it does when it is forced to bore its own way through the air medium.

In the Non-Arcing railway lightning arrester the discharge is caused to pass between two brass electrodes separated by half an inch and over narrow grooves burned into a block of lignum vitae. It must not be understood that this charred surface in any way acts as a conductor in the ordinary sense of the word. The discharge takes place not by conduction, but by disruption, leaping between the electrodes and over the charred surface, the latter acting simply as an electrical crack through the air and thus greatly assisting the passage of the electrical discharge; neither does this charred surface leak dynamo current, for the ohmic resistance between the electrodes is more than 50,000 ohms. If now a solid lignum vitae block be firmly screwed down over the charred grooves and metal electrodes it will be impossible for conducting vapors to form and the device is at once a non-arcing lightning arrester.



THE WURTZ NON-ARCING RAILWAY LIGHTING ARRESTER.

The arrester for line use is shown in the cut and for station use, one similarly constructed but mounted on marble base, neatly finished, is used.

The Westinghouse Electric & Manufacturing Company is making a series of experiments on the McKeesport and Wilmerding railway to determine the most effectual means of preventing injury to the machinery of street cars by discharges of lightning. As every one knows, lightning has a particular affinity for electric wires, which, naturally, are sui generis, and the amount of damage caused to the motors by lightning discharges passing from the wires through the machinery to the "grounds" is at times very considerable. In some instances the whole system has been tied up during the course of a severe electrical storm. The electric company has been giving the matter of lightning arresters some attention for years past. Last summer it maintained an expert all summer in Colorado observing and experimenting upon electrical storms, and now the experiments are being followed out on the McKeesport line. The immediate object in view at present is to ascertain how many of a certain pattern of arresters are necessary along a given line of road.—Daily Financial News.

The Bryant Special Receptacles.

The Bryant Electric Company has designed a special receptacle for theatre work, temporary display illumination and testing work in laboratories and colleges. Fig. 1 is an illustration of the first design and was used for the illumination on the Ferris wheel and the tower at the Midwinter Fair, San Francisco. The receptacle is also in use in the majority of college laboratories.

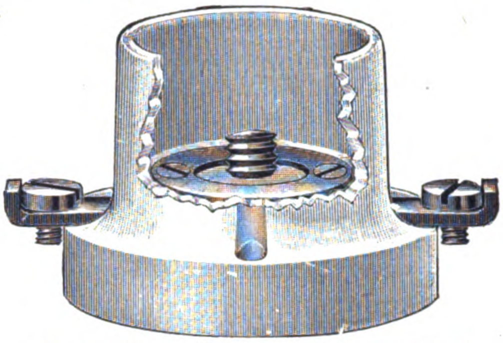


FIG. 1.—THE BRYANT SPECIAL RECEPTICLES.

Fig. 2 is the same receptacle with the design altered so that a shade-holder may be fastened to it. The porcelain is not as deep as in Fig. 1 and a brass ring or collar projects just far enough above the edge of the porcelain to permit of the shade-holder being attached. This ring or collar is the same size as any ordinary socket-shell, and any of the shade-holders on the market will fit it. This design is the latest of the Bryant company's specialties.

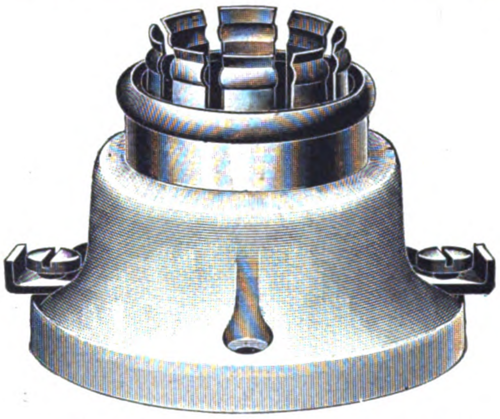


FIG. 2.—THE BRYANT SPECIAL RECEPTICLES

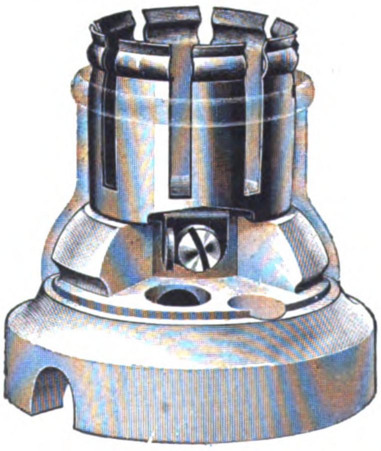


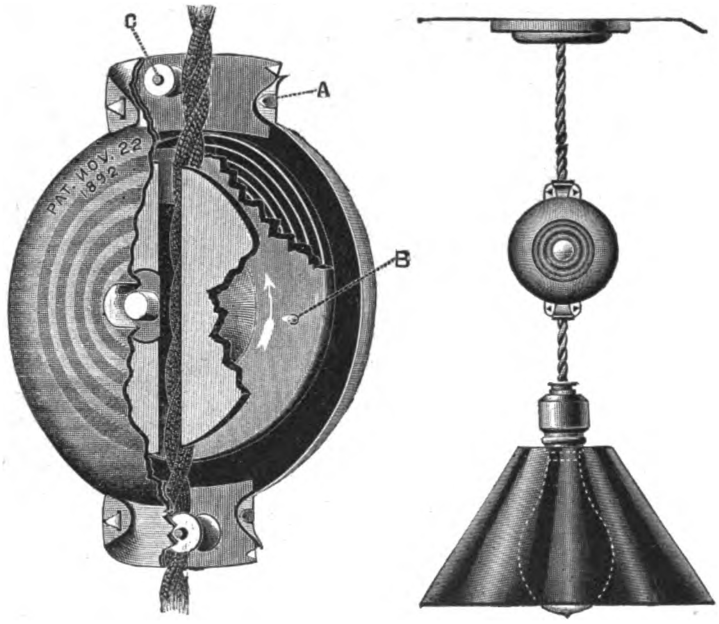
FIG. 3.—THE BRYANT SPECIAL RECEPTICLES.

Fig. 3 represents the same idea; although the design differs very materially from the other two receptacles, the purpose of this receptacle is for concealed work. The base is of porcelain and the shell of polished brass. The shell fastens to the porcelain base by means of small projections on the lower edge of the shell, and by giving the shell a half turn the base is firmly clamped to it. The Bryant Electric Company's western office, at 1532 Monadnock Blk., Chicago, in charge of Grier Bros., supplies the western trade.

The Porter Electric Light Adjuster.

For the instant adjustment of electric lights to any desired position a new adjuster has been placed on the market by Stephen Porter & Co., of 384 Atlantic Ave., Boston, Mass. The light is moved to the desired position and the adjuster instantly adjusts itself and holds the light in that position. The ease with which it operates is one of the advantages of the device. Of very simple, yet ingenius construction, there is nothing to get out of order.

In Fig. 1, which shows a section of the interior, it will be noticed there is a slot in the drum through which the cord passes. By removing the point B the spring is released and the slack cord is wound up. The outer shell is quickly replaced and secured so that the whole process of attaching the device takes but a short time. To prevent the cord wearing by sliding through the edges, small rollers, C, are used which protect the cord.



FIGS. 1 & 2.—THE PORTER ELECTRIC LIGHT ADJUSTER.

The shell is made of stamped brass, making a light article and giving it a finished appearance. The entire weight of the adjuster is but four ounces. Polished brass, copper or nickle plated, are the styles in which it is finished. The lightness of the attachment with no heavy weight to be raised and lowered, is a quality that facilitates its use and neither strains nor wears the different parts. The fact that it can be attached without cutting the cord or removing the rosette has made it a favorite with users of the electric light.

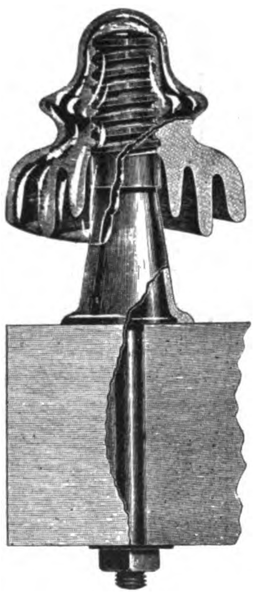
For lamps on which cords Nos. 14 and 16 are used the spring is properly adjusted and for lighter cords Nos. 18 and 20. By turning the drum back a turn or two it will be found to work satisfactorily. These goods are handled in New York by Geo. L. Colgate of 136 Liberty St.

It is expected the suit of the United States against the Bell Telephone Co. to annul the Berliner patent will come up for trial some time in June. Attorney-General Olney in a letter to the chairman of the patent committee of the house, says the proofs in the suit are now in.

Triple Petticoat Insulator and Pin.

A high grade of insulators and pins for line construction are manufactured by Fred M. Locke & Co., of Victor, N. Y. The accompanying cut shows a form of triple petticoat insulator and a patented pin. The pin is of steel, made with a strong base, which prevents the pin breaking off close to the cross arm. The seven-sixteenth pins are said to stand a strain of 1,800 pounds without bending. The pin is easily attached to the cross arm, and when firmly attached will strengthen the arm, and prevent large checks at the end. All tendency to split the arm as in the old style wooden pins is avoided.

The pin holds the insulator securely; the end being large and threads broad, no trouble is met with in putting the insulator on. The insulator as shown in the cut is designed for power transmission lines or high potential circuits, and is said to afford a perfect insulation for currents up to 10,000 volts. The triple petticoat affords a special protection against gathering water during storms or the formation of ice in cold weather. It gives satisfaction on all lines, and although designed for the high potential circuits the extra protection afforded any line should cause its use. The above firm makes a specialty of line material, and is designing a line of goods to meet the demands for material for high potential circuits, arising through the construction of many electric power plants.

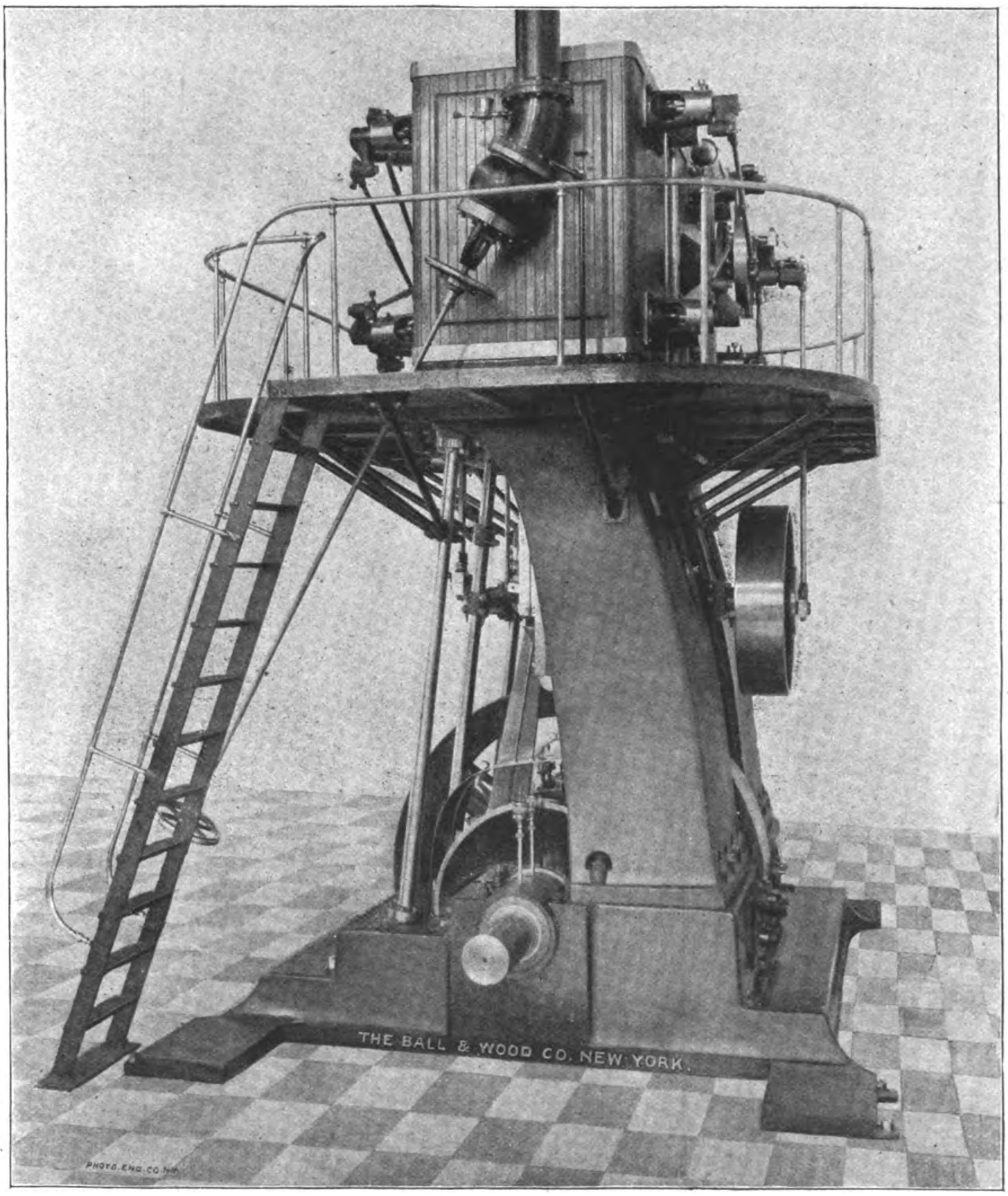


TRIPLE PETTICOAT INSULATOR AND PIN.

Mr. Schuyler S. Wheeler, electrical expert of the board of electrical control, said recently in the Morning Journal (N. Y.): I believe that the peril from electricity in all its varied applications is diminishing, in consequence of the rapid increase of knowledge of the subject. The greatest danger results from the fact that most people are ignorant of its powers and the proper safeguards. This ignorance at the same time causes them to be unnecessarily alarmed. Another important element of danger from this force is that its effects are instantaneous, and that there is no means of warning before any given trouble occurs. In the case of being burned, for example, heat is usually felt before the burning point is reached; but this is not the case with electricity. The safeguards against all electrical accidents on the other hand, are extremely simple and reliable, and I believe that in a few years the subject will be so thoroughly understood by every one that electricity will be much safer and more easily handled by all than any other force. There is an erroneous popular impression that many fires are caused by electric light wires, but the statistics show that this is not the case, but, on the contrary, fires from electric light wires are very rare. It is at present the custom to ascribe all fires in buildings where there are any wires to electricity, without regard to any evidence to show that the fire was so caused. In regard to the recent alleged case of hysterical blindness, I believe that it is purely a "fake."

New Ball & Wood Vertical Compound Engine.

The growing demand for vertical engines for lighting and power stations, especially in the large plants where floor space is at a premium, has lead the Ball & Wood Company of New York to place the improved type of engine shown in the accompanying engraving, on the market. Being the first of the kind manufactured and containing several points of interest, upon the completion of this engine the company invited a large number of engineers and steam users to be present when the engine was tested at the works before shipment. A considerable of interest was manifest by those who attended and the following brief description is here presented.



NEW BALL & WOOD VERTICAL COMPOUND ENGINE.

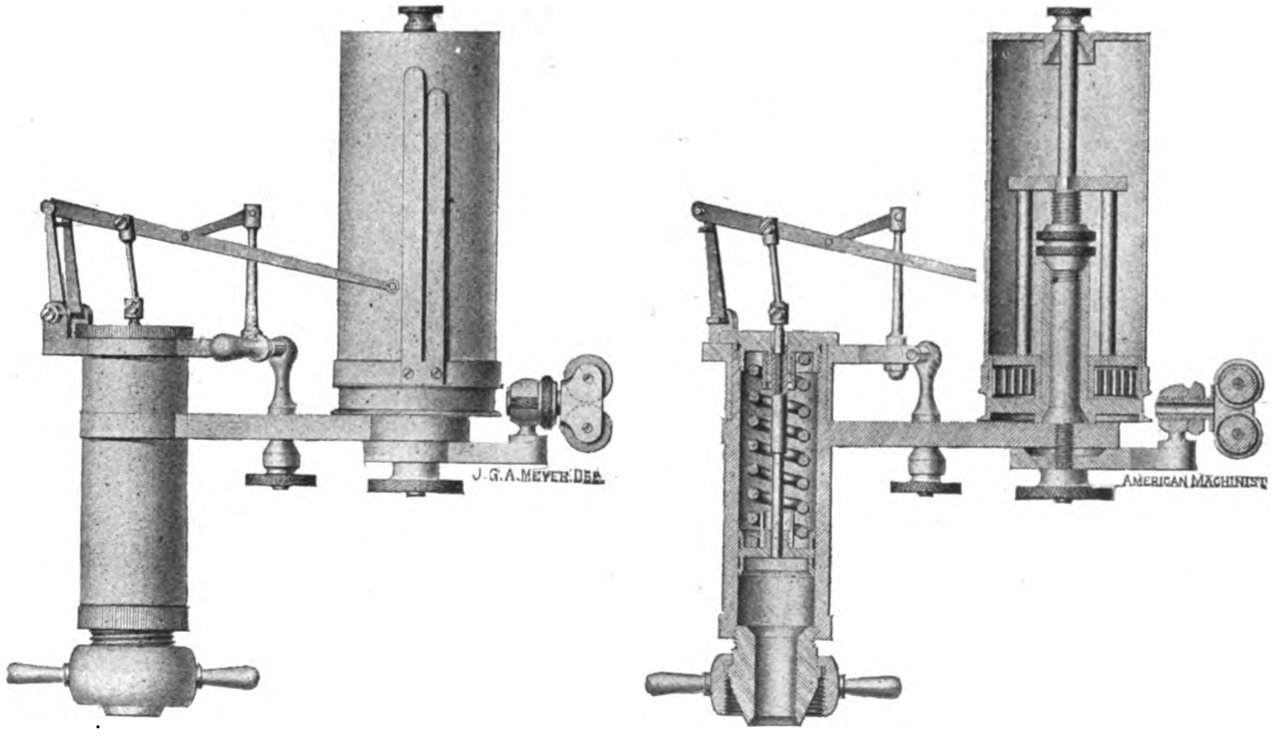
The engine in a cross compound non-condensing engine of 600-horse power. The cylinders are 19 and 31 inches respectively in diameter, and 24-inch stroke. It runs at a speed of 150 revolutions per minute with a steam pressure of 125 pounds. The engine will drive a dynamo on each end of the shaft, having been built for the 27th St. station of the Chicago Edison Co. The valves have the appearance of the Corliss but are modified after a new design which gives a speed 50 per cent in excess of that attained by the usual Corliss engine. The automatic cut-off is obtained by independently operated cut-off valves placed side the steam valves and actuated by a specially designed governor. A rapid cut-off and the wide opening of the ports secures a close and accurate regulation and a most economical operation.

The governing mechanism is of a special design, and one which has attracted the attention of engineers generally. It is of a design that does not easily get out of repair but can be depended upon either under light or under excessive loads. It communicates its motion through a special wrist plate to the cut-off valves. The location of the valves in the cylinder head, giving as it does the shortest possible ports, admits of their being of ample capacity without an appreciable increase of clearance. While the Corliss type is limited to a cut-off at one-half stroke, this gear is able to cut-off at three-quarters stroke.

As will be readily noticed from the cut, the engine is carefully and substantially built. It is firmly supported by a well proportioned base. The gallery erected gives easy access to any part of the engines. Abundant provision is made for lubricating all moving parts which are protected so that the oil is collected and not thrown from the engine. Although suitable for any service in which a stationary engine is used it is particularly fitted for the operation of direct connected dynamos and generators, the ends of the shaft being clear and unencumbered.

The Robertson-Thompson Indicator.

The accompanying cut shows the Robertson-Thompson indicator, manufactured by the Hine & Robertson Co., of Cortlandt street, New York. This instrument in standard size, with piston one-half inch in area, of good material and workmanship, is guaranteed by the makers to be equal in accuracy to anything on the market. The parallel motion is of unquestioned accuracy, and is secured by a controlling lever attached to the pencil arm, governing it direct, and the pivots are free from any appreciable lost motion, and will remain so indefinitely. It will be noticed by reference to the cut that the two links are parallel with each other at all points of the stroke, and that the lower pivots of these links are always in a straight line with the pencil point, and by substituting the controlling lever for the imaginary link, it forms an exact pantograph, without depending on the piston rod for a guide, the disadvantage of which we have already mentioned. It will be seen that the movement of the pencil coincides with that of the piston at all points of the stroke, a point of great importance. The drum is made of steel, hollow and threaded on the inside to receive a swivel rod, which permits of the adjustment of the pencil to any height on the drum. One and three-quarters inches in diameter, the drum is as light as is consistent with ordinary use. It is turned on centers, and provided with a bearing one and one-half inches long at the bottom and one-half inch long at the top, and is also provided with cone bearings at the top and bottom to take up end play on the shaft. The spring can be adjusted for any speed, high or low, by quarter revolutions. The guide pulley permits the cord being led in every possible direction without the use of carrying pulleys.



THE ROBERTSON–THOMPSON INDICATOR.

The instrument is easily adjusted, and can be changed from right to left hand. On account of its light moving it is perfectly adapted to engines of any speed met in practice. In the manufacture of the springs a fine quality of steel wire is used, and are carefully tempered and adjusted. It is very neatly put up in a polished hard-wood case convenient for carrying. The instrument is well made entirely of brass, nickle plated.

The Warren Engine-Dynamo.

The designing of direct connected engines and dynamos has received considerable attention recently from engineers. Many new types of both vertical and horizontal direct connected engines and dynamos have been built, marking an advance in the construction of machines for the generation of electricity. A still farther advance has been made by Messrs. C. C. and H. B. Warren of the Warren Electric Company, Chicago, who have just placed before the public an engine-dynamo, involving a compact construction for the output, a most economical use of material and the least possible internal loss. The design makes several departures from present practice. The fly-wheel is the only moving part of the generator, the body of metal in the wheel being utilized for the field magnets. It thus performs a double service, both its momentum and magnetic properties being utilized.

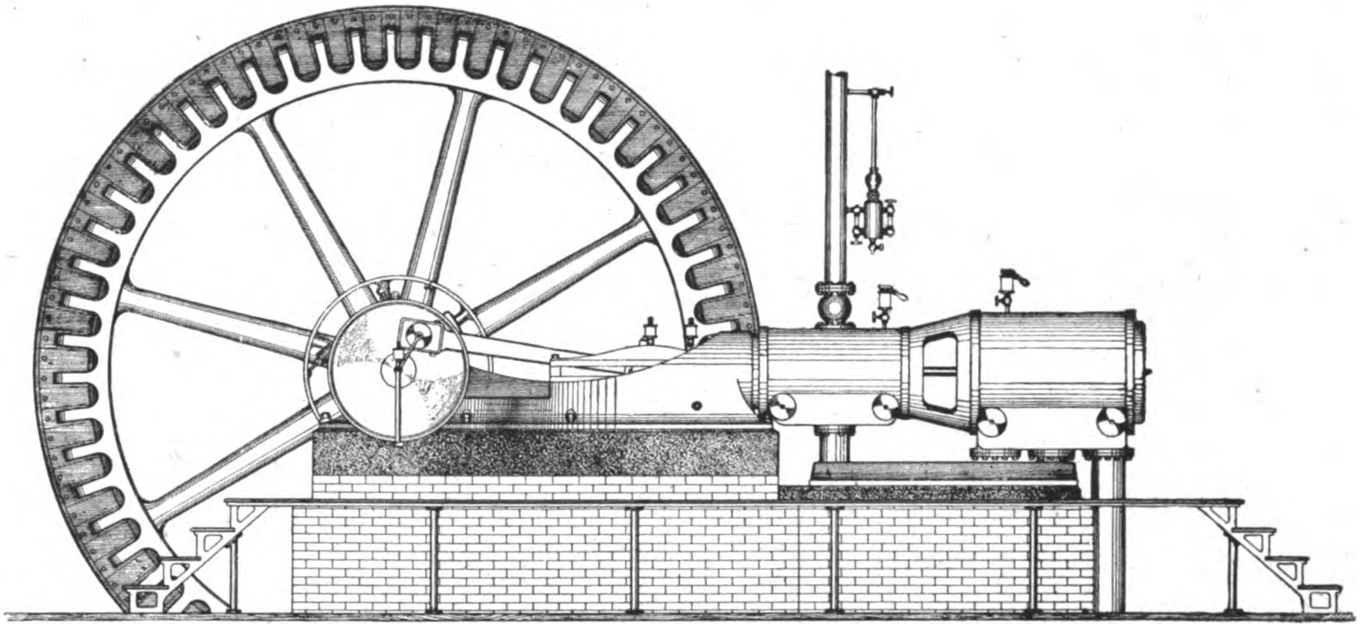


FIG. 1.—THE WARREN ENGINE-DYNAMO.

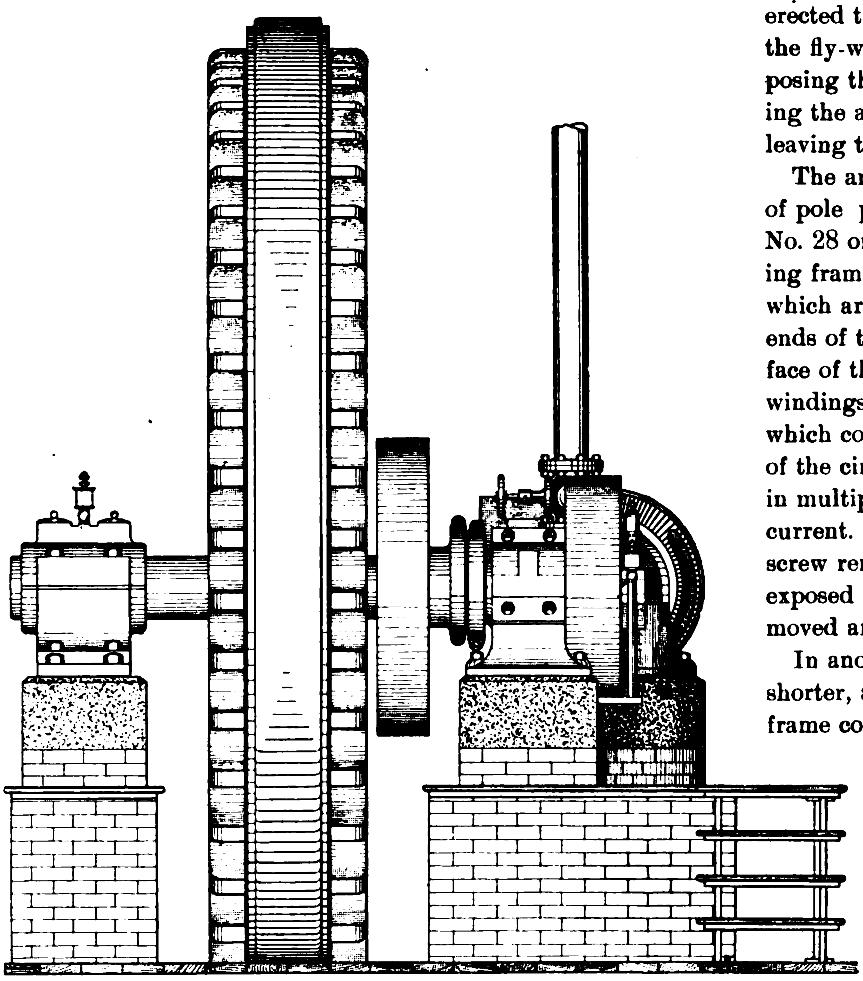


FIG. 2.—THE WARREN ENGINE-DYNAMO

The combination shown in Fig. 1 represents a 200-kilowatt direct connected alternator and tandem compound engine. Fig. 2 shows an end view and Fig. 3 a view of the armature and field coil. The fly-wheel has a large number of polar projections projecting in pairs from its face. Between these projections the field coil is suspended, encircling the fly-wheel, making one side of the fly-wheel the north pole and the other side the south pole. The projections in each pair are therefore of opposite polarity. The number of these projections depends on the speed of the fly-wheel. In the machine illustrated they number 112, the speed being 124 revolutions per minute, giving a frequency of 127 per minute. The face of these pole pieces is laminated to prevent eddy currents and their injurious effect. The fly-wheel is manufactured according to the method usually employed, the pole pieces being cast with the section of the wheel on which they are located. The field coil is wound on an insulated form of wood fibre which is suspended by a wrought iron frame. It is rolled to shape and made in sections for convenience. When the machine is erected this frame and insulating fibre form are attached to the fly-wheel. It is then slowly revolved and the wire composing the field coil wound on. When the frame supporting the armature is erected the field coil is attached to it leaving the fly-wheel free to revolve.

The armature cores, of which there are as many as pairs of pole projections, are built of punched laminations of No. 28 or 30 sheet iron. These are bolted to the supporting frame after being well insulated. The armature coils which are wound on insulating spools, are slipped over the ends of the armature cores, thus presenting to the interior face of the pole pieces on each side a series of separate windings. These coils are protected by insulating blocks, which cover the entire coil. The windings of each quarter of the circle are connected in series and these combinations in multiple, giving a voltage of 1,100 and 190 amperes of current. The coils are easy of access. The removal of one screw removes the insulating covering and leaves the coil exposed for inspection or repair, or it may be entirely removed and another inserted.

In another design of this dynamo the pole projections are shorter, as shown in the detail cut, and the supporting frame covers the entire face of the fly-wheel. The armature coils are placed directly opposite the face of the wheel, on separate cores placed between the cores described above, and projecting inwardly. Through insulated ducts on the frame the terminals from the series coils are joined and led from the machine. This design has several advantages, which are apparent to the practical man.

From the accompanying cuts and this brief description it will be seen that the main points in the design of this machine is the utilization of the fly-wheel which composes the entire revolving part of the dynamo as the pole pieces and yoke. The change in form of the fly-wheel will not ncrease materially its weight. There is no commutator, collector rings nor electrical windings or connections on the revolving parts. This method of construction is as easily applied to the corliss engine running 100 revolutions per minute with its 18-foot wheel as to the high-speed engine, running 240 to 300 revolutions per minute with 5 or 6-foot wheel. The combination is in every respect compact and occupies the minimum amount of floor space. There are no belts or counter shafting to occupy space or cause loss of energy.

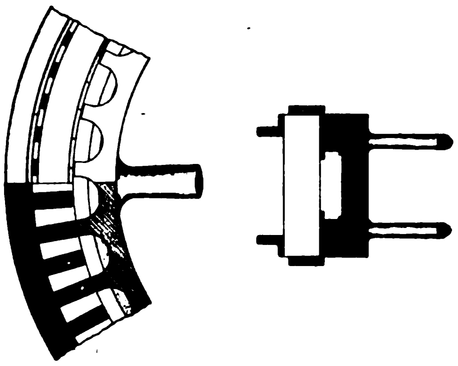
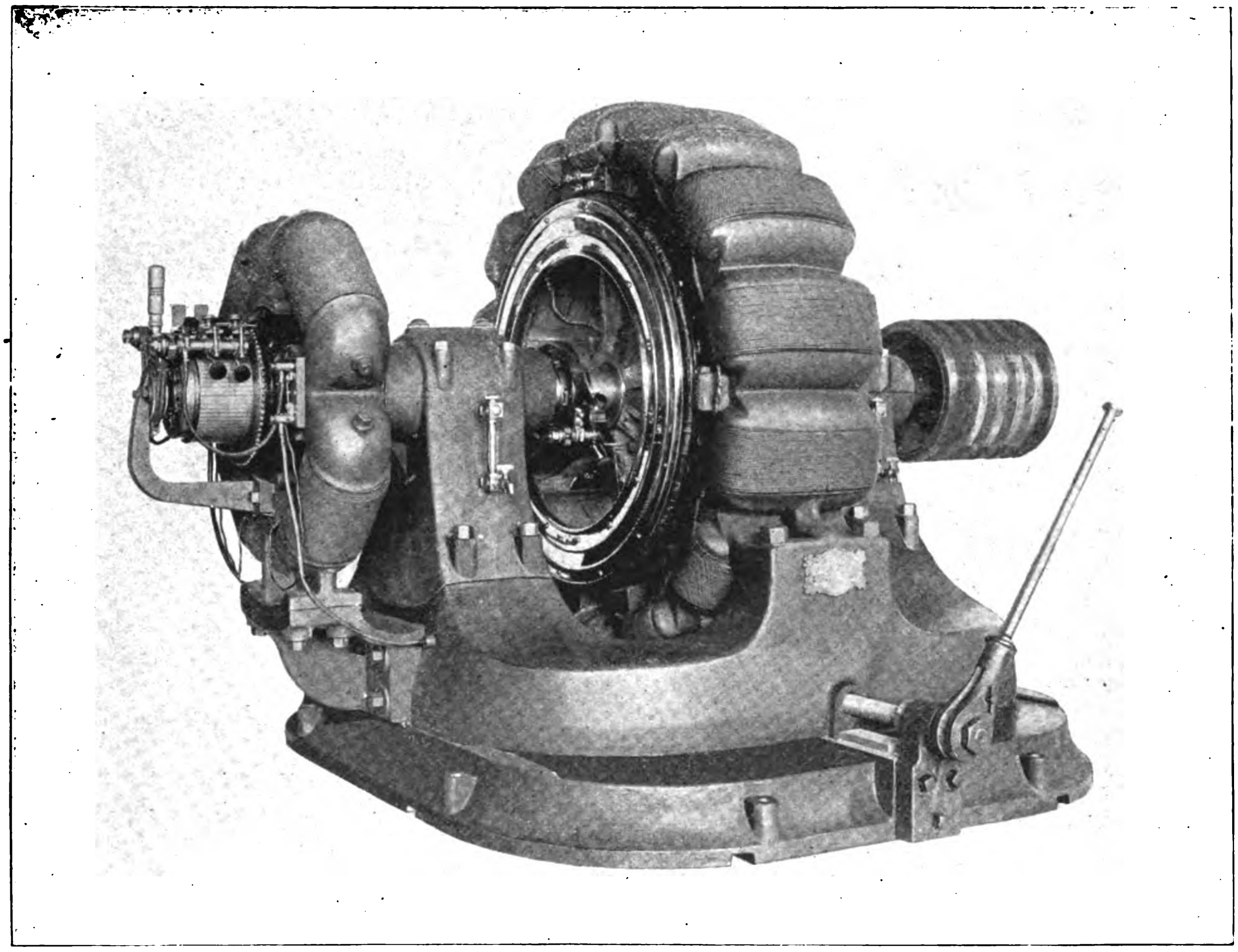


FIG. 3.—THE WARREN ENGINE-DYNAMO.

The output of the machine is easily changed from a high to low potential by changing the connections of the coils. This method of construction is applicable to any engine and many engines now installed may be fitted with these dynamos, the present fly-wheels being removed and a new one put on. It is especially well adapted to large units and permits of a large range in size and character of out-put. It can also be used in connection with water powers, the fly-wheel being attached to the shaft and the armature being built up as described in connection with the engine.


THE STANDARD ALTERNATING CURRENT SYSTEM.

The Standard Alternating Current System,

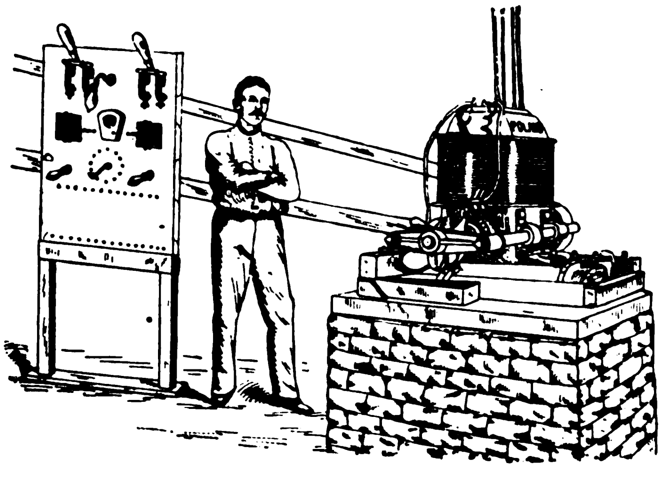
The alternating current dynamos shown in the accompanying cut has just been placed on the market by the Standard Electric Company of Chicago. It was designed by Mr. C. E. Woods, the electrician of the company, who has given it a thorough test during the past year. It is symmetrical in appearance and shows special skill in its mechanical design, while electrically, repeated trials have shown it fully up to the desired efficiency. The firm, well proportioned base, the large, self-oiling bearings with sight feed gauges, the neatly outlined fields, are some of the special points of its construction. It is supported on an iron sub-base with a right and left hand ratchet by which the machine may be moved to regulate the tension of the belt.

The armature is of the surface drum wound type. The spider construction, which is quite similar to the well-known arc machine, is especially strong and well constructed. This form of construction gives an excellent ventilation, which is always important. The exciter, which is quite similar to the new type of Standard direct current generator illustrated in the February number of Electrical Industries, is supported on the same base and its armature is mounted on the same shaft with the armature of the alternator but outside of the pillow block. The fields are supported on a bracket attached to the lower side of base as shown. The windings of the armature are cross connected so that but two brushes are required, which are placed on the upper side of the commutator 90 degrees apart.

The dynamo illustrated has a capacity of 1,250 16-candle power light. It operates at 1,100 volts and 60 amperes, revolving 1,070 times per minute. A full line of transformers are also manufactured by this company with the necessary instruments for the station. The line of alternating current apparatus is thus complete. The transformers which have several novel features were also designed by Mr. Woods.

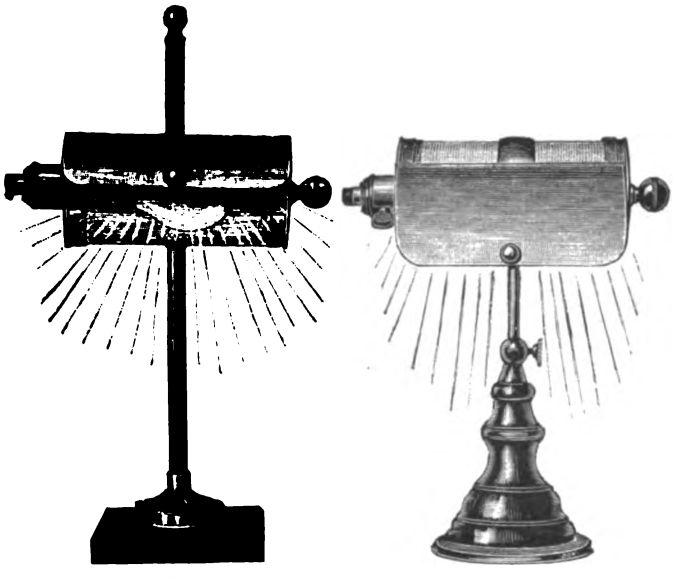
The Poland System of Electric Lighting.

The accompanying cut shows a sketch of an isolated lighting plant installed in the Forester Bakery at Cincinnati, O., by Mr. Lawrence Poland of 130 W. Second St. The dynamo as shown is of the bipolar type; the field coils are wound on spools and slipped over the pole pieces. The pole pieces are in one piece which gives a complete magnetic circuit without a joint. There is consequently no loss on account of the resistance from this source.



THE POLAND SYSTEM OF ELECTRIC LIGHTING.

The armature is of the toothed drum type with ample provision for ventilation. It is wound with a single layer of wires of comparatively large size which gives a low resistance and facilitates repairs. The coils are wound in mica insulated slots and are fully protected from mechanical injury. The shaft is large and is mounted in long, self-oiling bearings. The commutator is made of aluminum bronze and carefully insulated with mica. The dynamo is perfectly self-regulating and runs smoothly.



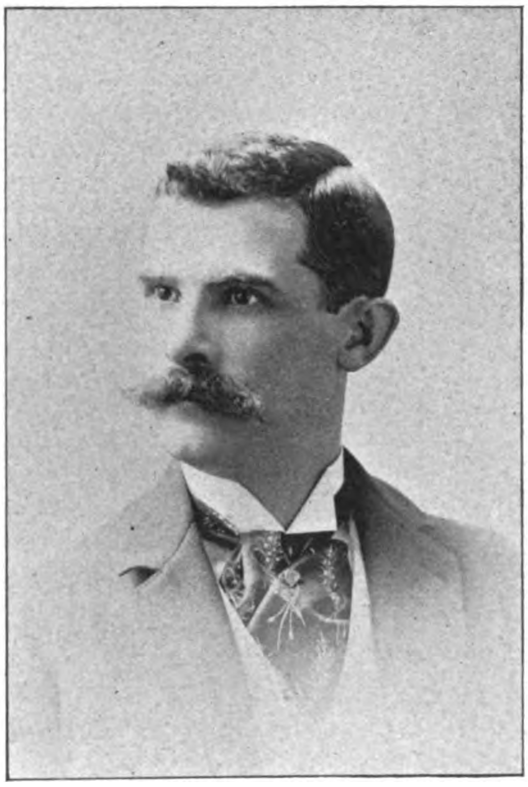
FIGS. 1-2.—THE KINSMAN PORTABLE DESK LIGHT.

The machine shown is of 15 kilowatts capacity. The regulating devices were also made at the works of Mr. Poland in Cincinnati. Dynamos are furnished in sizes from five to 500 incandescent lights and from one to 20 arc lights. A specialty is also made of motors from one-sixteenth to 10-horse power.

The Kinsman Portable Desk Light.

The incandescent lamp is without doubt the best light for reading, for writing or for any occupation which requires the continuous use of the eyes. The fixed bracket or electrolier often fails to throw the light where it is most needed, especially is this true in offices where the desk is placed against the wall and the light from the bracket is thrown directly in the eyes or from the electrolier upon the back instead upon the work in hand. To place in the market something that would meet the requirements of the office was the work of but a short time when the need of such an article appeared. The accompanying cuts show two of the forms of Kinsman desk lights placed on the market by McLoed, Ward & Co., of New York.

The lights are so designed that the light is thrown in any direction required, and at the same time the eyes are shaded. A touch of the finger changes the direction. Fig. 1 shows the eye shade down, while Fig. 2 shows the shade up. Fig. 1 is also somewhat more ornamental than Fig. 2. Both, however, are neatly finished, being nickel plated.



C. E. Gregory

Chas. E. Gregory.

Mr. Chas. E. Gregory, the subject of this short sketch, and whose portrait accompanies it, is probably one of the best known electrical men of the west. His long residence in Chicago has given him a large acquaintance, while his pleasant, aggressive manner has won him many friends in the electrical industry. Mr. Gregory was born in Newark, N. J., where he also received his education, with the exception of a course at Princeton. His residence in Chicago dates from the year 1879, when at the age of 20 he entered the employ of D. P. Perry, of this city, as salesman. He covered Wisconsin, Minnesota, Iowa and Nebraska for several years.

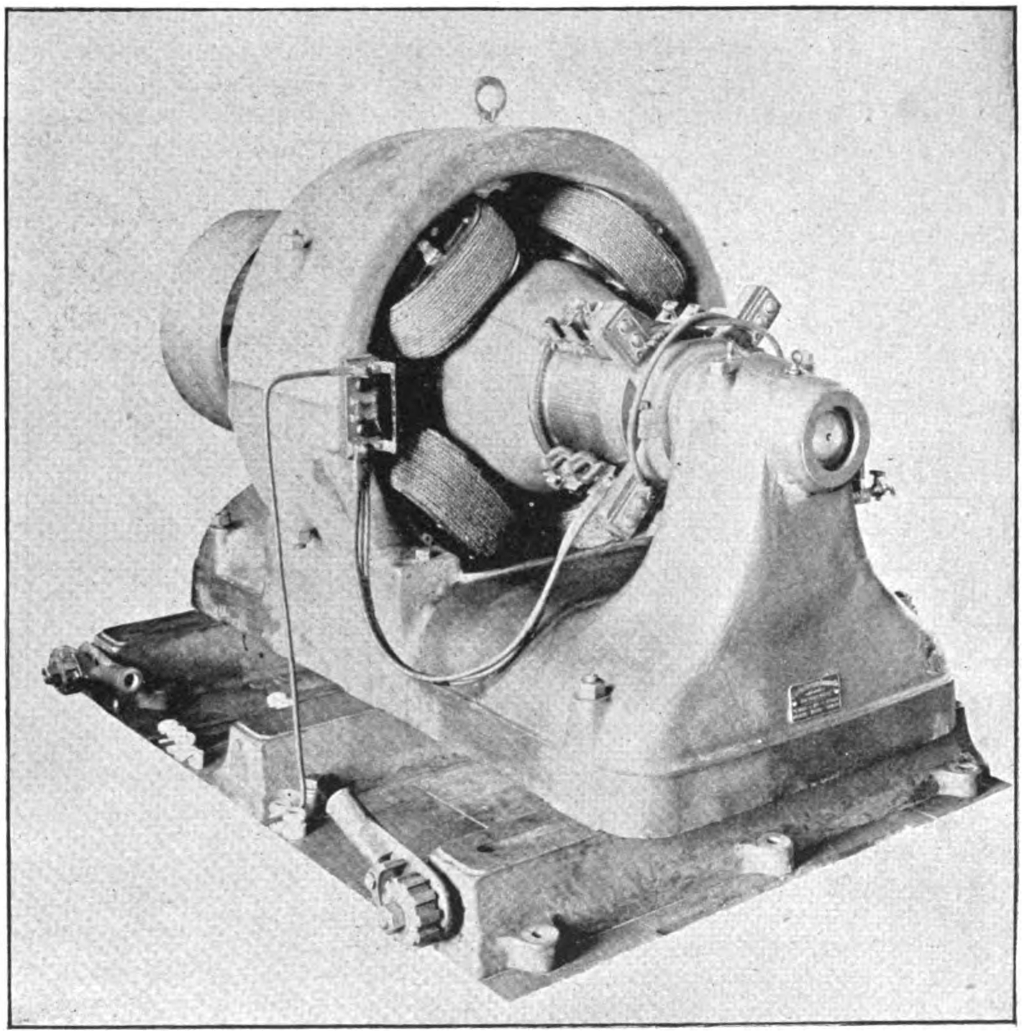
In the early eighties he became the manager of the Sun Electric Light Co., when there were less than 200 arc lights in Chicago. His experience with this company and other companies gave him a thorough knowledge of the operation as well as the management of central stations. His connec tion with the industry has been continuous since almost the inception of commercial lighting. In the organization of the Merchants Arc Light & Power Company, he took an active part and retained an interest in it until 1892. His connection with the Sperry Electric Company dated from the time its books were opened, until it was sold to the Standard company. For two years he was manager of the Hyde Park Electric Light & Power Co., and assisted in extending and enlarging that company.

In the fall of 1891, Mr. Gregory began business as a dealer in electrical machinery of all kinds. Among the first contracts was one for an arc light plant for a dredge working on the lagoons at Jackson Park, and another for the Columbian Commissary Co. These plants furnished the first electric lights at the World's Fair. In January 1893, the business having grown to such a size as to warrant it, he organized the Chas. E. Gregory Co., of which he became president and general manager. The Bain Electric Co., having consolidated with another company, its lease of the premises at 47 and 49 So. Jefferson St., and fixtures were purchased by this company. From a recent conversation it would seem that the business depression of the past few months had touched but lightly the business of this company and that the prospects for the future were even brighter. Mr. Gregory is comparatively a young man and may well look forward to a long and successful business life.

The Shawhan Multipolar Generator.

The electric generator shown in the accompanying engraving, built by the Shawhan-Thresher Electric Co., Dayton, Ohio, embodies many excellent points in its design. The illustration shows it as it is running in the powerhouse of the Dayton & Soldiers' Home Railway Co., Dayton, Ohio. The armature is of the tooth type, the coils being wound separately and each coil insulated in the most approved manner, thus reducing to a minimum the danger of short circuits. The commutator bars are thoroughly insulated with mica, and are set on compression frame, with the ends securely bolted in position, which renders it very strong and compact. The brush holders are so designed as to automatically compensate for the wear of the brushes and maintain a positive and even pressure upon the commutator.

The field coils are wound upon spools and thoroughly insulated, slipped over pole pieces and held in position by special clamp. All magnetic parts of the field are of steel, the lower half being cast separate from the base, to which it is carefully fitted and securely bolted in position. The bearings are self-aligning and self-oiling, placed in journal boxes cast in one piece with the base and have large oil chambers for lubrication of the bearings. The center of gravity is very low, and its construction renders it very strong and rigid. This machine has a capacity of 40 kilowatts, wound for 500 volts, with a speed of 600 revolutions, and is compounded to increase the pressure five per cent at full load, and in delivering 80 amperes, the electro-motive force is 525 volts.


THE SHAWHAN MULTIPOLAR GENERATOR,

It has been in operation the last four months sixteen hours a day, and has given excellent satisfaction. The Shawhan-Thresher Electric Co. are prepared to furnish this type of generator from 40 to 300 kilowatts, either belted or direct connected, and in connection with their iron clad motors, illustrated by us some time ago, makes a splendid power transmission apparatus. The company possesses superior facilities for the manufacture of these machines, together with an experienced corp of engineers.

A BRIEF REVIEW.

St. Etienne may well be called a workingman's town. Fully three-fourths of its 133,000 inhabitants derive their support from the mine, the gun factory, the foundry, and the loom. Of this large body of wage-earners by far the most intelligent are the weavers, numbering about 30,000. Frugal, industrious, and law-abiding, they afford an interesting example to the student of the labor problem of the effect of "home work" upon the relations of capital and labor. Of the 18,000 looms in St. Etienne, the greater number are owned by the individual weavers and worked by hand in their own homes. While it is apparent that the recent inventions for the transmission of power by electricity will shortly effect an alteration in the methods, it is not thought that it will change, to any great extent at least, the location of the work. Until very recently the ribbon-weaver, laboring in his own home, could see no room for improvement in the mechanical execution of his work. From time immemorial the long bar had been worked by hand. Brought up to it from childhood, and inheriting the prejudices of his class, it was difficult to convince this member of an ancient guild that any advantage could be gained by the substitution of any other power for that of his own sinewy arm. Of late, however, his eyes have been open to the wonders of that subtle agent which is so rapidly transforming the mechanical work of the world, and today it is not a rare occurrence to find a humble weaver who can talk to you of dynamos and motors with the intelligence of a practical electrician. Already over sixty looms are being worked by electricity, the force being furnished by the Edison Electric Company. This company has for several years supplied the light to a large number of shops, hotels and saloons in the city, but more recently, with commendable enterprise, it has undertaken to furnish electric force to the numerous looms in the district. To this end it has established an elaborate electric plant on the River Loire, at the foot of a picturesque village, St. Victor-sur-Loire, situated about eight miles from St. Etienne. A waterfall of 900-horse power sets in motion three turbines which transmit the electric force through four cables, seven millimeters in thickness, to its destination. As has been stated, over sixty looms are now in operation worked by electricity furnished by this company, and the director informs me that he anticipates a great increase in the number during the next six monhts.—Advance Counsular Reports.

For the guidance of inventors in securing patents, Edward P. Thompson gives some concisely stated information in the Electrical Engineer of April 4th, respecting divisional patents. A careful study of the points will give the inventor a check on the ignorant or fraudulent attorney, should such be intrusted with securing the patent. In the article referred to Mr. Thompson says: "I have attempted to unravel the apparantly intricate relations existing among the patent laws and decisions, and to present the result so that the inventors may easily grasp the idea, I think, and get the gist of the law, but at the same time I do not guarantee accuracy equal to that of the long and involved sentences found in patent law books.

"1.—It is not only an axiom, but the statement of law, that one patent cannot protect two or more inventions, and that two or more patents cannot protect one invention.

"2.—If an invention must be divided into two or more parts, danger is usually removed by describing only what is claimed in the respective applications.

"3.—If two or more inventions are put into one application, the rules of the office forbid adjudication until the inventor chooses which he will retain. If the examiner lets them go through inadvertently or otherwise, the patent may stand void as to one of them at least.

"4.—Each patent may rightly contain one set of claims on the broad idea and one set on one way of carrying out the idea; but not upon a second or third way. Example: It may contain broad claims covering a carbon transmitter and another set on a particular mechanical construction, but not on two distinct mechanical structures. A development of this principle may result in the grant of a hundred or more valid claims in one patent where the invention is upon a single intricate machine. The Mergenthaler typesetting patents had an average of seventy-five claims per patent.

"5.—If an application describes two inventions and claims are permitted to cover but one of them, the other should be withdrawn, whether or not a subsequent application for a patent upon it is contemplated.

"6.—If two pending applications both show, but claim, respectively, only one invention, they should contain cross-references disclosing this fact.

"7.—Inventions are not only divisible from a technical point of view, but sometimes as to method or process, machine or apparatus, and substance or product. The laws regarding these are too intricate to disclose their various phases here; but the inventor should have this general information."

Mr. I. H. Babcock has a communication in the Electrical Engineer in which he, referring to an article on furnishing exhaust steam for heating purposes published a year ago, says: "Since that time the Springfield Electric Light & Power Co. has made quite a large extension of its heating mains, and also contracted for the exhaust steam from the electric railway company, having laid a ten inch main to connect with the exhaust pipe at the railway power station. This gives a continuous supply of exhaust steam day and night in the territory occupied. The income from heating, has increased more than 50 per cent. over the previous year, and will amont to $12,000 this present season. We have the statement of their manager that the total expense, chargeable to the exhaust steam account, will not exceed $2,000, leaving a net income, due to the exhaust steam addition to the electric plant of $10,000. The total investment on this account, has not been more than $25,000; the annual cost repairs up to the present time has been practically nothing; it is not, therefore, surprising that the electric light company is more than ever enthusiastic over the success achieved in this added branch of its original enterprise. At the present rate of growth of its steam heating business, it is not too much too expect that within two years its net income from the sale of exhaust steam, will pay a very handsome dividend upon the total investments for both steam and electricity.

This condition does not call for any special comment, as the facts speak for themselves. A good many other electrical companies have been watching what they regard as the experiment of the Springfield Electric Light Company in its use of exhaust steam; and it is a matter of no small moment to all of them. It is the current belief that electric light companies are now working on a very liberal margin of profit. They have to compete with the gas companies, who have been able to reduce the cost of gas making materially, and although electric lighting is a great step in advance, yet it is a fact that the price still controls to a great extent, and not the quality. The gas companies will not be driven from the field, and will be found doing business at the old stand for many years to come.

The electrical field has been a favorite one for investors for the last few years, and an immense amount of money has been placed in these enterprises. How to make the business profitable is now a matter of the first importance with these corporations. The laws of competition and traffic cannot be evaded, and are as binding as any other laws regulating human affairs. The stern reality of these laws enforces still more the necessity for economy in conducting the business affairs of companies. If the company can coin $10,000, or any other amount of money out of what it now allows to go to waste. it is by such an act looking after the interests of its stockholders in a practical way. On the other hand, if it allows the value of $10,000, more or less, to go to waste, which it might coin into so many dollars, it must stand convicted of neglect and of a failure to conduct its affairs with common business prudence."

Some interesting statistics have been compiled in Germany concerning the use of steam engines as motors in electricity works and private installations, and the progress of electric motors in that country. It appears that the number of steam engines employed for driving dynamos in 1891 was 794, of a total power of 39,610-horse power. In 1892 this number had increased to 944 engines, of 52,292-horse power; and in 1893 to 1,218 engines, of 66,528-horse power. It is noteworthy that of this 66,528-horse power no less than 48,692-horse power was used for operating dynamos for the production of current for lighting purposes; whilst 1,286-horse power was devoted to the transmission of power, the remainder being employed for a variety of purposes. As might have been expected, the greatest development in electric lighting has taken place in Berlin. This is also the case in regard to the utilization of electric motors in that city. In June, 1893, there were connected to the mains of the Berlin Electricity Works 238 motors of 780-horse power, and at the end of December last this figure had advanced to 336 motors, representing a total of 1,086-horse power. A striking feature in connection with the use of these motors is the fact that the average power of the motors in operation at the close of last year was only 32-horse power. Whilst this figure may be regarded as extremely low, it demonstrates at the same time the gradual extension in the use of small motors in industrial and other operations. The motors are utilized for a variety of purposes, including the working of ventilators, printing machines, lifts, cloth-cutting machines, turntables, and circular saws, and in chemical works; and in a few cases for the driving of dynamos. It would be interesting to learn how many electric motors are connected to the mains of the metropolitan electric-light companies.—Mechanical World.

Notwithstanding all that may be said in favor of using mechanically induced draft with economizers, much of which was set forth in our first page article of last month—says Power for April—the impression should not be gained that economizers cannot be run to good advantage with ordinary chimney draft. As a rule, gases pass to the chimney in the vicinity of four hundred degrees. This temperature can be reduced a hundred or a hundred and fifty degrees without spoiling the draft in a chimney of ordinary mill height and ample area, with a considerable increase in the efficiency of the plant, by the transfer of the escaping heat o the entering feed. The station described on the first three pages of the present issue, and the Kent avenue station at Brooklyn described in our October issue, are two out of numerous instances where this is successfully done. It would be possible to reduce the temperature to a degree that would seriously interfere with the operation of a practicable chimney, and it is the saving of these last units, together with the advantages set forth in our previous article, that mechanically induced draft finds its application. Another reason for the growing use of economizers is found in the increasing tendency to higher rates of combustion. Slow combustion and large boilers have gone out with sixty pound pressure and three hundred feet piston speeds. The best results are found to be attained by working boilers full up to their rated capacity, and making all the heating surface effective, even at the expense of a little increase in the terminal temperature. The economizer furnishes a means of reclaiming this heat which would otherwise be rejected, so that even with a higher furnace temperature and a greater amount of work obtained from a given installation of boilers there is no greater amount of heat discharged than with the low rate of combustion.

In no field has the progress of the electric light been more marked than in its application to the lighting of passenger and other steamships. No passenger vessels are built nowadays without provision being made for fitting them with the electric light, and very many cargo vessels are also provided with the same illuminant. Indeed, the introduction of the electric light has, to a certain extent, revolutionized the social habits of ocean travelers, who, after once enjoying the comfort of a brilliantly lighted saloon, refuse to take a birth in an oil-lighted vessel. Even the steerage passengers now have the electric light. The crews quarters are similarly lighted; and in the engine room and stokehold the engineers and firemen go about their work in a blaze of light unknown in the old days of the oil lamp. Even the coal trimmers have their portable electric lamps in the bunkers. Coincident with the introduction of the electric light, the number of fires on board ships has decreased, for by far the majority of fires which used to occur at sea were distinctly traceable to the indiscriminate and careless use of matches in lighting oil lamps, and to the breakage or explosion of the oil lamps themselves. A source of heavy expense, too, in connection with passenger vessels lighted by oil lamps, is now removed, viz: The frequent necessity of renovating saloons, state rooms, etc., owing to the rapid deterioration to which furniture and decorations were subject when exposed to the fumes and sooty products given off by oil lamps. The latest addition to the electric lighting plant of an ocean steamer is the search-light, which is fitted in the bows. The standard searchlight for this purpose has a projector of 16-inch diameter, giving a light equal to about 20,000 candle power. The apparatus is carried in an iron cage, which also accommodates the operator. It is made with a slot which fits on to the stem of the ship, and thus guided, it is lowered to the water's edge when the ship is nearing her anchorage. In this position the cage can be fixed temporarily to the stem by bolts, and the operator can flash the light along the surface of the water, lighting the whole area for a great distance, and enabling the buoys to be picked up easily in the darkest night.—Age of Steel.

A flywheel accident is reported in the engine room of the Royal Electric Co's plant at Montreal, Que. A fire started in the station and before the engineer could shut down the engine the flywheel burst, seriously injuring two men and wrecking the building.

Our Recent Departure.

Since inaugurating the change last month in the directory feature of ELECTRICAL INDUSTRIES, in publishing in separate form the directories of Electric Light Central Stations and Electric Railways, we have received scores of letters from every part of the country complimenting us upon the change. We give without further comment a few of the many kind words of approval received:

WHAT A FEW OF OUR SUBSCRIBERS SAY OF THE CHANGE.

"Another step forward in your already valuable paper."
Theo. Sparks, Santa Fe, New Mex.

"An improvement that will be appreciated."
Walla Walla Gas and Elec. Co., Walla Walla, Wash.

"A decided step in advance."
Zanesville Elec. Lt. Co., W. O. Perry, Supt., Zanesville, O.

"Meets our hearty approval."
Harpeth Elec. Lt. & Pr. Co., Franklin, Tenn.

"Of very great advantage."
Windsor Elec. Lt. Co., Windsor, Vt.

"The change is a decided improvement. I like the paper much better."
W. B. Sanford, Pipestone, Minn.

"A very good move and will be appreciated by your subscribers."
C. S. Dill, Goshen, Ind.

"The change is a good one."
Geo. A. Farwell, Waukesha, Wis.

"This change is in our opinion a good one."
Edison Illuminating Co., Detroit, Mich.

"Much more convenient."
Englewood Elec. Lt. Co., Chicago.

"The change is an excellent one. Your directory of supply houses we find of great use."
Citizens Elec. Lt. Co., Goshen, Ind.

"Much better than the old way."
Caro Elec. Lt. Works, Caro, Mich.

"The change is an excellent one."
Jno. E. Waite, Chillicothe, Mo.

"The change is O. K. It is the boss electrical monthly."
R. J. Shephard, Charleston, Mo.

"It is a very good departure, as it will give timely topics room for a proper treatise."
Roy G. Allen, Whitman, Mass.

"The change is excellent."
Shippensburg Elec. Lt., Ht. & Pr. Co., Shippensburg, Pa.

"A great improvement."
E. E. Larrabee, Bennington, Vt.

"It is a decided improvement."
Lynchburgh Elec. Co., Lynchburgh, Va.

"The change is in our opinion a good one and should please everyone."
J. O'Connell, Cortland, N. Y.

"The change is in our opinion very good indeed."
F. W. Epley, New Richmond, Wis.

"The change is a very good one."
J. H. Mills, Jr., Poplarville, Miss

"It is very convenient."
S. M. Highlands, Clinton, Ia.

"The change is very much for the better."
C. B. Gowen, St. Simons Mills, Ga.

"The change is an excellent one."
J. R. Parsons, Earlville, N. Y.

"The change is good."
Henry B. Holmes, Springfield, Vt.

"The change is a wise one."
H. V. Lincoln, Leicester, Mass.

"A good one."
Rock Hill Elec. Lt. Co., Rock Hill, S. C.

"The change is very good indeed."
Lafayette St. Ry. Co., Lafayette, Ind.

"The change is a very good one."
G. L. Cole, Beloit, Wis.

"A great improvement."
Parkersburg Elec. Lt. & Pr. Co., Parkersburg, W. Va.

"A great improvement over your former publication."
Lincoln Gas Co., Lincoln, Neb.

"We like the change very much."
Macon Gas & Elec. Lt. Co., Macon, Mo.

"Very desirable."
E. Wilkinson, West Point, Va.

"The change is a good one and I am well pleased with your paper."
W. J. Harrington, Marengo, Ia.

"The change is a good one and of great service to the trade.
W. N. Sherman, Merced, Cal.

"Is a step in the right direction."
Heppner Lt. & Water Co., Heppner, Ore.

A FEW OPINIONS FROM ADVERTISERS.

"The change is A1."
Iona Mfg. Co., Boston.

"A departure in the right direction."
Shawhan-Tresher Elec. Co., Dayton, O.

"The change is an excellent one."
Washburn & Moen Mfg. Co., Chicago.

"Your Quarterly Directory is a very useful and satisfactory reference."
The C. McIntire Co., Newark, N. J.

"The change, in our opinion, is an excellent one, and it enables us to keep your valuable list of General Stations in our desk in a compact and convenient form."
McCreary Elecl. & Specialty Co., New York.

"In our opinion it is a decided advantage over the old directory."
Boston Braid Mfg. Co., Boston.

"This change is in our opinion an improvement."
Weston Elecl. Instrument Co., Newark, N. J.

"The change is what should have been done long before this."
Elecl. Supply & Contracting Co., Cincinnati, O.

"It is more convenient and satisfactory to us."
The Lane & Bodley Co., Cincinnati, O.

"The change is a good idea."
Phillips Insulated Wire Co., New York.

"An excellent one."
Houston & Kennelly, Phila.

"It is an improvement."
Jas. Leffel & Co., Springfield, O.

"It is a great improvement."
American Elecl. Works, Providence, R. I.

"The change is in our opinion a good one, being much more convenient to handle when referring to it."
Eastern Elec. Cable Co., Boston.

"It is better."
Hart & Hegeman Mfg. Co., Hartford, Conn.

"The change is an excellent one."
Tryon Investment Co., New York.

"It is a great improvement."
Cherry & Younglove, Syracuse, N. Y.

"This change is in our opinion wise."
Alfred F. Moore, Phila.

"An improvement."
Shawmut Fuse Wire Co., Boston.

"The change is one of the very best."
Clonbrock Steam Boiler Works, Brooklyn, N. Y.

"More convenient for filing and reference."
Commercial Elec. Co., Indianapolis, Ind.

"An excellent idea."
A. L. Ide & Sons, Springfield, Ill.

"An improvement."
Ball Engine Co., Erie, Pa.

"This change, in our opinion, is a good one."
Western Electric Co., Chicago.

"A decided improvement."
Stanwood Mfg. Co., Chicago.

"The change is a good one and deserves well of advertisers."
J. H. Cooke, Chicago.

"The change is a good one."
Metropolitan Electric Co., Chicago.

"A very great improvement and the directory will be invaluable."
Wallace Electric Co., Chicago.

"Just what I want on the road. Concise and convenient."
E. H. Fox, Western Mgr. Phœnix Glass Co., Chicago.

"The best thing we have ever seen."
Excelsior Heater Co., Chicago.

"Just what is wanted."
Jas. I. Ayer & Co., St. Louis.

"This change is a good one."
Standard Electrical Works, Cincinnati.

"The change is in our opinion an exceedingly happy one."
Cushing & Morse, Chicago.

"This change is a very wise one."
Jno. Wood, Jr., Conshohocken, Pa.

"In our opinion the change is a good move. We like the 'shape' of the directory."
Geo. Cutter, Chicago.

"It is an improvement."
Simplex Elecl. Co., Boston.

"The change is most praiseworthy and much more convenient."
Elecl. Engineering & Supply Co., Syracuse, N. Y.

"It is a decided improvement."
Columbia Incandescent Lamp Co., St. Louis.

"We are much pleased with the change."
Blair Lamp Adjuster Co., Omaha, Neb.

"The change is a good one and a departure in the right direction."
Keystone Electric Co., Erie, Pa.

"We like it."
Clark Electric Co., New York.

CORRESPONDENCE.

LETTERS FROM PRACTICAL MEN.

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay and in this way the value of this column to every one will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—Ed.]

Editor Electrical Industries: I am running an electric light plant in which we have a Thomson-Houston arc light machine, a Stanley 500-light alternator and a National Electric 750-light alternator. Every once in a while I find that the incandescent lamps on one of the circuits appear to pulsate considerably, even when the circuits are not fully loaded, but as they do not do this at all times I am at a loss to account for it. Can you give me any instructions by which I can trace out the cause, and remedy the difficulty? Sometimes the lamps do not flicker as much as at other times and sometimes it is so bad that the consumers complain and threaten to give up the lamps if it is not remedied. I have studied over this thing for nearly two months now, ever since we put in the last machine, and I would like some one to tell me what is the trouble.

J. M. C., Oil City, Pa.

The trouble may be due to slipping of belts or in the regulation of the engine driving that machine, as the governor may not work properly and the engine will race more or less. This is more likely to be the case if the engine is regulated by a fly ball governor than if it be an automatic or shaft governor. If tightening the belt does not stop it, try the effect of carrying about five pounds more pressure and see if that does not stop the pulsation. Another cause for such action might be, if two alternating circuits run parallel for some distance, the self induction between the two parallel circuits might cause such an effect, as it has frequently been noticed, especially when one of the lines is heavily loaded; but this effect appears only near the end of the lines. If these suggestions do not help you to discover the cause and work out a remedy, write us again describing the plant more fully and mentioning particularly the kind of engines you employ and also how the circuits run regarding the one on which you have the trouble.

Editor Electrical Industries: What is the cause of the bands on an armature coming loose? All of the wire band that hold the armature wires in place are getting loose and if it continues will cause trouble. How can I tighten them, or will it be necessary to put on new bands? The armature was repaired about a month ago and has run all right except that the bands are beginning to show a looseness. All of them are about the same. Is it caused by the stretching of the bands on account of the expansion and contraction due to changes of temperature when running and when the machine is cool?

J. M. M., Pueblo, Colo.

The trouble is not due to expansion and contraction, as you suggest, for that would not be enough to strain the wire beyond its elastic limit, consequently the wire would not stretch. The trouble is due to the way in which the armature was banded when it was repaired and it is not that the band wires have stretched, but that the insulation on the armature wires have shrunk. When the armature is dried out, after it has had new wires put in, the heat and shellac causes the insulation to swell and when it gets cold and shrinks it will leave the bands loose, if they were put on before the armature was baked. The permanent bands should be put on when the armature is warm just after it has been baked. We infer that the repairs were made by a novice at armature winding; otherwise the bands would not have become loose.

Editor Electrical Industries: One of the dynamos running incandescent lamps in the plant that I have charge of acts very queer, and we cannot get at the cause of the trouble. Some say that it is caused by one of the armature wires being broken, but I have tested it with a magneto and can find nothing wrong. Others say that the belt slips, but I am running it as tight as I can without heating the bearings too hot. Another man says that the engine is at fault. I do not know what is the cause of the trouble. I have tried everything that has been mentioned that I thought would do any good, but cannot get rid of the trouble. The dynamo is a U. S. and the engine is a high speed with shaft governor. I set the valves of the engine so that they are all right. The trouble is that the belt keeps jumping and the lights flicker so that it is hard on the eyes to read by the light. Can you tell what is the matter?

C. M. H., East St Louis, Mo.

The cause of the trouble, as you described it, appears to us to be in the engine, instead of in the dynamo or belt. If you will put an indicator on the engine and take some diagrams you will find that the valve is not equally divided and that one end of the cylinder takes more steam than the other, because the valve does not close soon enough on that side. This causes the engine to pulsate and the irregular motion is communicated to the dynamo and it shows in the lamps. If you will listen at the exhaust pipe you can tell that the engine valve is out of adjustment. If you have no indicator, or cannot get one, you can adjust the load equally on both sides by lengthening, or shortening, the valve rod as required to equalize the valve. Make but little change at a time, and, if making the adjustment without an indicator, listen to the sound of the exhaust as each change is made and when no difference can be detected, each exhaust sounding the same, leave it in that position and the belt will not jump afterward. Engine valves should always be set by the aid of an indicator, as there is difference in the adjustment when the engine is hot, from what it is when cold.

Editor Electrical Industries: There is one place on the incandescent circuits in the building where I am running that bothers me greatly. Whenever I put a new lamp in there it will appear all right, but so soon as I start up and the lamp begins to burn the carbon filament will curve over towards the glass, finally touching it and burning out, but if I take the lamp out of that socket and put it in another place the filament will hang straight. Every lamp that I put into the socket mentioned acts the same way and it is quite a curiosity to those who have noticed it. The lamp hangs vertically from the holder, which is in a side bracket. there is a speaking tube that runs very near this lamp down to the dynamo room; do you think this can have anything to do with the way the lamp acts, as the filament curves toward the tube, no matter how it may be when first put in, but unless the lamp is burning the filament does not curve toward the tube. G. W. P., Marinette, Wis.

Puzzles of this kind are rather hard to solve unless full information is given and we would ask: Where does the lower end of the speaking tube terminate? Do you ever notice any indications of an electric charge on the tube—that is, do sparks ever fly from it? Does this tube end or pass near a belt that is in motion? If the tube is in such a position that it becomes electrified from the belt when the dynamo is running and it is sufficiently well insulated to retain an electric charge, we can readily understand that it would draw a filament towards it as there is an attraction between the filament and an electrified body. If this surmise does not suit the case and you cannot see any connection between the action of the lamp and the points mentioned, give us further information regarding the location of tube and other things that might influence the lamp and we will try to ascertain the cause.

NEW INCORPORATIONS.

The Peotone Electric Co., Peotone, Ill., was incorporated April 11, with a capital stock of $6,000. The company will furnish electric lighting.

The Hamillon-Elliott Telephone Co., Coffeyville, Kan., was incorporated April 16; capital, $6,000.

To enter the field of telephone construction, the Mutual Telephone Exchange Construction Co., of Rahway, N. J., with capital of $50,000.

Of Newark, N. J., The Automatic Electrical Specialty Co., with a capital stock of $10,000.

For the manufacture of electric apparatus, toys, etc., the Electric Toy Company, Brooklyn, N. Y., April 10; $10,000 capital stock.

The Port Richmond Electric Co., Port Richmond, N. Y., incorporated April 7, for the commercial production of electric lighting, heat and power.

Mount Minsi Electric Railway Co., Stroudsburg, Pa., for the construction and operation of electric railway; $25,000; April 4.

The Lancaster & Lititz Electric Railway Company, Lancaster, Pa., was incorporated on April 4, for the construction and operation of electric railways. Capital stock, $100,000.

The Lancaster & New Holland Railway Company, Lancaster, Pa., to operate electric railway, $100,000.

Wellsborough, Pa.—the Wellsborough Electric Co., with capital stock of $7,000.

Coopers, W. Va.—The Bluestone Electric Light Company; $50,000.

San Francisco, Cal.—Electrolytic Reduction Company, for the reduction of ores: $1,000,000 capital stock.

The Northern Telephone & Telegraph Company, Chicago, Ill., capitalized at $10,000.

For the operation of an electric light and power plant at Spirit Lake, Iowa, the Stevens-Industrial Steam Electric Co.; $10,000.

For the manufacture of dynamos and other electrical machinery, installing plants and systems of light and power, the Wisconsin Electric Dynamo Co., capitalized at $50,000; main office and works at Milwaukee, Wis.

At Chariton, Iowa, the Chariton Telephone Co.

The Electric Light Company of Tipton, Iowa, with $12,000 capital stock.

Burwick, Me., the Burton Electric Heating & Forging Co., with capital stock of $1,000,000.

The Butte Lighting Company was incorporated on April 13, for the manufacture of gas and electricity. The capital stock is placed at $1,000,000.

Of Waterloo, N. Y., the Waterloo Light & Power Co., for the purpose of supplying electric light, heat and power.

The Beaver (Pa.) Valley Telegraph & Telephone Company was chartered April 27 with an authorized capital of $25,000. The directors are Almon R. Lydea, John T. Reeves and John A. Elliott, of Beaver Falls; Jacob D. Martsolf, of New Brighton; John T. Hoffman, of Rochester; Albert M. Jolly, of Wheeling, W. Va., and James J. Davidson, of Beaver.

Petaluma, Cal.—The W. S. P. Telephone Company on April 18th, capitalized at $250,000.

Victor, Colo.—The Victor Light, Water & Power Co., to furnish electric light, water and power in Victor on April 18th, $100,000.

The Electric Smelting & Aluminum Company of Chicago, Ill., on April 21st, with a capital stock of $100,000.

At East St. Louis, Ill., the St. Louis Electric Brake Co., acquiring patent rights, relating to cars, brakes, etc., on April 24th, $2,000,000.

Martinsville, Ind.—The Martinsville Electric Company on April 25th, with $10,000 capital stock.

Milford Telephone Company, Milford, N. H., on April 20th, $1,000.

New Jersey Postal Telegraph & Telephone Company, Newark, N. J.; $500,000; on April 25th.

Savoy Machine Co., New York city, for the manufacture of electrical machines, on April 19th, $2,500.

Baker City, Ore.—The Baker City Electric Light Company on April 21st, with a capital stock of $60,000.

Pittsburg, Pa.—The Etna & Glenshaw Street Railway Co.; $50,000; to operate electric railway.

Knoxville, Pa.—Knoxville Electric Light & Power Co., to supply electric light, heat and power, capital stock, $3,000.

Harborton, Va.—The Peninsula Telephone Co., on April 24th, with capital stock of $5,000.

Sturgeon Bay, Wis.—The Electric Conduit Company, for the manufacture of and dealing in electric machines on April 25th.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Durand, Wis.—Dr. F. J. Gobar is seeking a franchise for a light plant and it is expected that the council will take action in the matter on May 3d next.

Rock Island, Ill.—The Peoples Power Company has purchased the Brush and Merchants light plants.

Prescott, Ariz.—The Prescott Electric Light & Power Company expects to add another dynamo soon. S. F. Wynkoop is purchasing agent.

Connersville, Ind.—The Connersville Gas Light Manufacturing Company has contracted for a new 300-horse power engine. Anthony Watts is purchasing agent.

Tuscola, Ill.—The Tuscola Light & Power Company contemplate the addition of another boiler next fall. F. M. Friend is purchasing agent.

Marietta, Ga.—The Marietta Electric Light Company contemplate the addition of a new engine and boilers, also an alternator.

Englewood, Ill.—An isolated plant requiring three 300 light incandescents and the necessary engines is to be put in. Second hand machinery, if in first-class condition, would be accepted. W. W. Hays is purchasing agent.

Pana, Ill.—The Pana Modern Electric Light, Power & Street Railway Company may add a day circuit for motor use. J. C. Hadley is purchasing agent.

Eureka, Cal.—The Eureka Lighting Company, the Humboldt Electric Light & Power Company and the Eureka Gas Company have been consolidated under the name of the Eureka Lighting Company. The work of transferring all machinery to one central station is now under way. Its power plant will be materially increased.

Noblesville, Ind.—The Noblesville Light & Ice Company will add an engine and an ice machine. A. L. Evans is purchasing agent.

Grundy Center, Ia.—The town has decided to have a plant but nothing will be done at present. Address W. F. McLane.

Evanston, Ill.—The Evanston Electric Illuminating Company is about to add a 2,400 light machine. J. S. Crider is secretary.

Scranton, Pa.—The Anthracite Electric Light, Heat & Power Company reports that its plant will not be built until spring of '95.

Spencer, Ind.—The Spencer Electric Light Company may add five arc lamps. W. S. Mead is purchasing agent.

Michigan City, Ind.—The Lake Cities Electric Railway Company has purchased the Municipal lighting plant. Frank H. Root is the purchasing agent.

Hartsville, Mass.—The Berkshire Electric Light, Heat & Power Company is awaiting the decision of the state commissioners. If it be in its favor, a plant will be built. The hearing is set for May 3d next. O. W. Lane, Great Barrington, Mass., is vice president.

Aspen, Colo.—The People's Light & Power Co., contemplates the purchase of a 1,000-light alternator; also a 50-light arc machine. E. Ford is purchasing agent.

Merced City, Cal.—The Merced Electric Light Co. within the next three or four months proposes putting in a new 100-horse power engine. A. C. Swain is manager and purchasing agent.

Grand Junction, Colo.—The Grand Junction Electric & Manufacturing Co. has just put in a new 85-horse power Armington & Sims engine and a new Westinghouse 750 light dynamo. C. F. Lacombe is purchasing agent.

Trinidad, Colo.—The Trinidad Electric Light, Heat & Power Co. is contemplating putting in a 200-horse power water tubular boiler this summer. W. A. Wright is manager and purchasing agent.

Norwalk, Conn.—The Norwalk & South Norwalk Electric Light Co. will put in a line shaft and a new boiler this season. B. C. Yeaton is superintendent and purchasing agent.

South Norwalk, Conn.—The City of South Norwalk hopes to do commercial lighting next October, if the citizens vote in favor of it. W. S. Bonnel is manager; A. E. Winchester purchasing agent.

Jacksonville, Fla.—The Jacksonville Electric Light Co. has discontinued city lights, as it found the price too low to be profitable.

Columbus, Ga.—The Brush Electric Light & Power Co. will probably add a motor circuit soon of 5,000 volts. W. E. Boileau is manager and purchasing agent.

Hiawatha, Kan.—The injunction case recently appealed will be heard the first Monday in May. If the city is sustained, plant will be put in immediately.

Parkersburg, Chester Co., Pa., has appointed a committee consisting of T. J. Kennedy, Chas. Hemans, S. D. Park and M. C. Mullen, to report on the subject of electric light for the city.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

Fremont, O.—The Fremont Street Railway Company is now changing its motive power to electricity.

Toledo, O.—The Toledo, Maumee & Perrysburg Electric Street Railway Company proposes to have its road ready for business by July next.

St. Louis, Mo.—The Baden & St. Louis Railway Company's line is now in process of construction. It is expected that it will be completed about June first, next.

Lancaster, Pa.—The Lancaster & Philadelphia Electric Railway Company, of which Mr. John S. Graybill is president, has decided to build a line from Downington to Westchester.

Houston, Tex.—The Houston Rapid Transit Company, which has a 35 year franchise, will build its road through the business portion of the city, and extend it to the park and race track. The line is to be 16 miles in length. H. T. D. Wilson is vice president.

Redlands, Cal.—The Redlands Electric Light & Power Company are in the market for material for a proposed line, as follows: 650 tons 50 lb. T rails, 700 poles 27 feet, 12x12 tapering to 8x8, 1,000 ties 5x7x6 feet, 14 miles of copper wire, 7 miles ⅝ inch wire rope, 2-16 foot cars complete with two 15-horse power motors. H. H. Sinclair is president and general manager and W. C. Butler engineer.

New Britain, Conn.—The Central Railway & Electric Company contemplate an extension of four miles to Berlin.

BUSINESS NOTES.

Messrs. Horne & Martin are now getting settled in their new quarters in the Old Colony building, Van Buren, Dearborn and Third Ave. Mr. Martin, although not fully recovered from his recent accident, is able to be around a part of the time.

Taylor, Dee & Mack has just moved to 320 Dearborn St., the Manhattan Bldg., where it will have a more advantageous location and better facilities for the transaction of its constantly growing business. A large stock of supplies is being received and arranged in the new warerooms.

The General Incandescent Arc Light Company of New York is putting on the market a full line of single and double pole switches for central station use. The workmanship and design of these switches are of the very best. Mr. S. Bergmann is the president of the company and his long experience in this line of work assures their success in the market. A full line of these switches is carried in Chicago, Mr. L. E. Frorup being in charge of the branch office.

Mica Insulator Co., 218 Water St., New York, has been sending out some samples of the new micanite cloth which is used for general purposes of insulation. As now manufactured it is non-absorptive and remains flexible indefinitely. It is put up in rolls 32 inches wide and 16 feet long. The new forms in which micanite is being moulded have rapidly increased as it has been more generally adopted in the manufacture of electrical machinery and apparatus.

The Sunbeam Lamp Mfg. Co. of Chicago, is now permanently located in the Chicago Title & Trust Building at 100 Washington St. This central location will give the company every convenience in the transaction of business. Recent circulars sent out by the company give considerable data of the Sunbeam lamp. It is made in sizes from six to 32 candle power. To suit the wants of customers the 16 candle power lamp is made in two styles high efficiency and long life.

The Great Western Manufacturing Company is arranging its extensive stock of electrical supplies, fixtures and dynamos in the more extensive quarters at 116, 118 and 120 Market St. Better accommodation for its stock and greater facilities for the transaction of business places the company in a better position for caring for its extensive trade. The offices and salesrooms are very pleasantly situated. The warerooms are larger and will accommodate a large stock of supplies and apparatus.

Bartholomew, Stow & Co., manufacturers of the Hyperion arc lamp and dealers in electrical material, have removed from 57 Michigan Ave., to their new quarters, 19 North Clinton Street where they have larger and better facilities for carrying on their growing business. This firm has recently added to its membership Mr. Wm. I. Marshall, a gentleman of considerable means and large experience, whose addition will be a valuable acquisition to the working force necessary to carry on its already successful business.

Pullman's Palace Car Co., Pullman, Ill., report among recent orders the following: Six open trail cars, for the Chicago North Shore St. Ry. Co.; fifty closed motor car bodies, for the Brooklyn City Railroad Co.; fifteen single truck and ten double truck closed motor cars for the Chicago General Street Railway Company; two open motor cars, Kingston City Railroad Co. Rondout, N. Y. In addition to the above the company has just completed and is now shipping 40 open cars to the Brooklyn City R. R. Co.; also, two closed motor cars to the Mobile Light & Railway Co., Mobile, Ala.

The Central Electric Company, Chicago, is now located at 173 and 175 Adams St. The offices and sales-rooms have been entirely refitted during the past month, and now present an elegant appearance. The facilities now possessed by the company are second to none. In addition to the standard lines of goods with which the name of the company is closely associated, a number of new specialties and lines of goods have been added. The factory of the company at Columbia City, Ind., is in full operation. The Kinsman desk lights illustrated in this issue are handled by the Central company.

Mr. E. B. Latham, for the past ten years connected with the interests of the T. H. Co., and later the allied interests of the General Electric Company, has severed his connection with the above and will hereafter carry on the business of consulting electrical and mechanical engineer, at 239 La Salle st., Chicago, giving special attention to the interests of owners of central stations throughout the United States, acting as advising representative, as well as "middleman" between purchaser and manufacturer. Mr. Latham's long experience has given him a knowledge of machines and construction work, which is most enviable and fits him thoroughly for the lines that he has laid out to follow in his seemingly entirely new departure. We bespeak for him a bounteous share of the success which he deserves.

FINANCIAL.

REPORT OF GENERAL ELECTRIC COMPANY.*

It is needless to say that the past year has been a most trying one to all corporations. It has been especially so to companies like your own, dealing with local enterprises situated in all parts of the United States, and largely dependent on normal conditions for their success and development. During the summer of 1893, even old and strong customers were obliged to ask for leniency in paying their accounts and notes. Under these circumstances, your company found itself with its own obligations to meet, but unable at that time to collect the money with which to meet them. The difficulties thus presented were carefully considered by your Board and were met by selling to a syndicate certain of the company's assets consisting of claims against, and stocks and bonds of, local lighting and railway companies, the same being of a class of which your company sold several million dollars in 1892 and which your directors, in their last report (pages 6 and 7), said they intended to continue to sell from time to time as heretofore "through the ordinary channels." The channels through which your company usually made such sales having become unavailable owing to the panic, your directors adopted a plan used on several occasions in the earlier days of the Thomson-Houston Company, and made the sale of assets above described to a syndicate which paid over $4,000,000 in cash. Although the transaction involved a large shrinkage from book valuations, the sale was at a price high under the conditions then prevailing. Few of the securities sold were listed on any exchange or commonly dealt in, and it was not possible to effect a ready sale except in bulk to a syndicate. These assets were placed in a trust known as "The Street Railway and Illuminating Properties." After the financial stringency had subsided, the right to subscribe to them was offered to the stockholders of your company.

The depreciation in value of the assets thus sold applies equally to those still on hand. Holders of stocks and bonds of almost every kind find them quoted to-day much lower than a year ago, and this company, as a holder of electrical stocks and bonds, is no exception to the rule. In fact, the shrinkage in values of electrical securities has been greater than in most others. The last year has been characterized by shrinkage in every direction, and your company has suffered severely from it.

Since the combination of the Edison and Thomson-Houston companies in 1892, your directors have been earnestly endeavoring to simplify your organization. As a result of the union, your company suddenly came into control of some twenty sub-companies, all engaged in active exploitation and having their own separate boards of directors and independent managements, with separate accounts and liabilities. At first your Board had little success in its efforts to centralize and simplify the organization, but the events of last summer emphasized the necessity of radical changes so unmistakably as to secure the co-operation necessary to effect the desired results. The "District Offices" are practically abolished, except as mere sales-offices. The business management of the company has been concentrated at its principal office at Schenectady and its whole organization has been greatly simplified. All accounts are kept there, and all sales and credits are supervised there. So far as practicable, your manufacturing business has been and will be concentrated at Schenectady; and the operations of its other factories are now directed from there. During the short time since this change was effected, many advantages have accrued to the company from this concentration of the selling, accounting, manufacturing and engineering departments of the company.

Besides the shrinkage in the inventory value of the securities of local and other companies hereinbefore mentioned, as sold and on hand, there is a shrinkage in the inventory value of apparatus and material at factories and storerooms and of machinery and fixtures at storerooms amounting to $2,382,012.94. This shrinkage is partly due to the fall in value of material manufactured and in process of manufacture, aad partly to the development in electrical science which has been so great during the last year or two that apparatus which at the time of the last inventory was looked upon as commercial has been superseded by entirely new and superior types. Consequently, the older apparatus has become unsalable, or of slow sale, and most of it has been reduced to "scrap" value and the remainder to much less than cost.

LICENSEE COMPANIES.

The substantial and permanent character of the business of local illuminating companies, distributing light and power by the methods, and protected by the patents, controlled by your company, is more widely recognized year by year. The true interests of this company lie in advancing the interests of its licensees in every possible way, and to this end prices of apparatus have been reduced during the past year, and the licensees will continue to receive from time to time the benefit of further reductions in cost of manufacture.

PATENTS.

Substantial progress has been made during the year in the prosecution of suits against infringers of many of the more important patents belonging to the company. The "feeder and main" patent which is of fundamental importance, particularly for low tension lighting plants, has been sustained by the Circuit Court for the District of New Jersey.

The litigation on the incandescent lamp patent has been generally successful, although the most strenuous efforts have been made by infringers to defeat the patent or devise some form of lamp that would be outside of it. In two instances we have met with reverses in this litigation which have proved to be comparatively unimportant. In these instances we are advised there is a strong probability that we shall ultimately prevail. The efforts to evade the patent by so called "lamp repairs," and by injecting a harmless amount of inert gas into the bulb, have been defeated.

Our counsel are hopeful that the courts will so construe the law that the lamp patent will run for the full term for which it was granted, in spite of the fact that the situation is somewhat complicated by foreign patents. If we succeed in maintaining this positisn, the patent will be of substantial value to the company for some years.

Owing to the inevitable delays of litigation, the important cases on patents for railway work, upon which we place great reliance, have not yet come to hearing. It is expected that many of these cases will be determined during the coming year.

No final decision has been rendered against the company on any patent. During the past year several such suits against the company have been decided in its favor, notably the suit on the patent for the hydro-carbon treatment of the filament of incandescent lamps which has been disposed of in our favor by the decision of the United States Circuit Court of Appeals.

Upon the whole, the patent situation seems to be promising, and we believe that at the next annual meeting we shall be in a position to report substantial progress.

All expenditures for patents and patent rights during the year under review, and all expenses of patent litigation, have been charged to operating expenses.

During the year the sum of $884,659.11 has been expended in additions to the manufacturing plants, and their equipment. On the other hand the sum of $902,058.34 has been written off to profit and loss for depreciation, leaving the cost of such plants on the books $3,941,128.98, which is $17,399.23 less than they were carried at January 31, 1893.

The supplies of raw material, manufactured goods, and goods in course of manufacture, at the factories, have been carefully inventoried, item by item, and a reduction of $1,217,142.81 has been made from the sum at which they were previously carried. The supplies of finished apparatus in the different local salesrooms of the company and on consignment have been dealt with in the same manner, and the sum of $940,365.03 has been charged off on them.

As to the notes and accounts receivable (of over 6,000 customers) there is, in many instances, among those whose duty it is to pass upon their value, a wide difference of opinion. They have been classified, item by item, and your board has taken them at the lowest suggested valuation. The amount includes $2,531,609.88 due by the Fort Wayne, North West and other allied interests.

ORGANIZATION.—Numerous vacancies, principally due to resignations, have occurred in your official organization during the year and have been filled as indicated in the list of officers which accompanies this report. The selections to fill such vacancies have, in every instance, been made in recognition of general merit and of fitness especially displayed during the severe strain of the last eight months. During the year, the entire internal organization of your company has been readjusted and the number of departments has been reduced. This has resulted in a large saving of expense and increased efficiency. Your board now feels that the *personnel* of your organization is adjusted in a manner where few changes among subordinates are likely to be made in the early future, and a general appreciation of this fact will lead to more efficient work than was possible during the transition period.

CONSOLIDATED BALANCE SHEET*—JANUARY 31, 1894.

ASSETS.

Patents and Franchises		$8,159,264.92
Manufacturing Plants		3,941,128.98
Real Estate (not including factories):		
Edison Building, N. Y. City	$412,356.13	
Less mortgage thereon	200,000.00	
Carried forward	$212,356.13	
Brought forward	212,356.13	
Other Real Estate	111,329.10	
		323,685.23
Stocks of Manufacturing Co.'s	2,767,470.58	
Stocks and Bonds of Local Co.'s	2,723.493.17	
		5,490,963.75
Cash	591,143.88	
Notes and Accounts Receivable (Face value $14,984,697.42)	8,935,159.75	
		9,525,303.63
Inventories:		
At Factories	3,349,042.94	
At Sales Offices (including consignments)	1,485,749.68	
		4,834,792.62
Work in Progress		1,198,343.58
Profit and Loss		12,454,967.42
		$45,928,449.23

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*Abstract of report.

*General Electric Company, Edison Electric Light Company, Edison General Electric Company, Thomson-Houston Electric Company, and Thomson-Houston International Electric Company.

LIABILITIES.

Capital Stock:			
Common	$30,459,700.00		
Preferred	4,251,900.00		
			$34,711,600.00
5% Gold Coupon Debenture Bonds			10,000,000.00
Mortgages			26,200.00
Accrued Interest on Debenture Bonds		83,333.32	
Notes Payable		744,341.31	
Accounts Payable		323,084.82	
			1,150,759.45
Sundry Credits			39,889.78
			$45,928,449.23

Trade during the past month has not been very steady; a goodly number of orders have been received for supplies and a number of good contracts have been let, but the trade in general has been spasmodic. The most noteworthy event in the stock market is the steady advance of the Westinghouse stock. The confidence in the management of the company seems to have increased. The orders now on the books of the company are said to be sufficient to keep the full force of employes busy throughout the season. Western Union has advanced slightly while Bell Telephone has recovered former prices. The stock of the General Electric remains about the same. The decline from the effect of the annual report was quickly recovered. The business of the company is said to have greatly improved, but in the competition prices are said to have fallen, reducing profits on contracts received. Among the annual meetings held during the month was that of the Joseph Dixon Crucible Co. The meeting proved most satisfactory. The old board of managers was re-elected. Upon the board being organized Mr. E. F. C. Young was elected president, Mr. John A. Walker vice-president and treasurer, and George E. Young secretary.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING APR. 25.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	191
" " "	Bds. 1898.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co... ...	Com.	14,000,000	100	....	....	85
Commercial Cable Co	Com.	7,716,000	100	....	....	120
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	F. Q.	115
" " " ...	C.Bds. 1898.	71,000	100	6	M. & S.	.....
" " "	C.Bds. 1901.	586,500	100	6	M. & N.	.....
" " Brooklyn..	Com.	2,500,000	100	....	Q. F.	85
" " " ..	1st. 1940.	500,000	100	5	A. & O.	100
" " " ..	Regis.	....	100	5	A. & O.	.....
" " Chicago...	Com.	3,000,000	....	8	Q. F.	135
" " "		2,500,000	....	....	....	.....
" " New York.	Com.	7,938,000	100	....	Q. F.	100
" " "	1st 1910.	2,562,000	100	5	M. & S.	107
" " Phila......	Com.	1,473,000	100	....	....	120⅛
" " "		....	....	5	....	.....
Fort Wayne Elec. Co...... ...	Com.	4,000,000	25	....	....	3½
General Electric Company.	Com.	30,457,000	100	....	......	38¾
" "	Prf'd.	4,251,900	100	....	....	70
" "	Deb. 1922.	10,000,000	100	5	J.-D.	70
Gold & Stock Tel. Co...........	Com.	5,000,000	100	....	Q. J.	... .
Northwestern Gen. Elec. Co.....	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	750,000	100	....	J. Q.	.....
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	......	.....
Thomson European Welding Co.	Com.	1,500,000	100	...	....	.....
Thomson-Houston Elec. Co . .	Series D.	120,000	10	...	....	5⅜
Thom'-n-Houst'n Intern. Elec. Co.	Com.	600,000	100	.	....	.....
" " " "	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co....	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q J.	84½
" "	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	38½
" " "	1st Pf.Cum.	3,755,700	50	7	....	52
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R..............	Com.	6,000,000	10	....	Q.-J.	170
" "	1st Bds.1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	....	Oct. 1.	.....
" " " ..	1st Bds.1909	300,000	100	5	J. & J.	....
" " " ..	Certf. 1894.	300,000	100	6	J. & J.	....
BUFFALO—						
Buffalo St. Railway.............	Com.	5,370,500	100	5	....	.....
" "	Bds. 1931.	5,000,000	100	....	F. & A.	.....
BOSTON—						
West End St. Railway..........	Com.	9,085,000	50	..	J. & J.	47
" "	Prf'd.	6,400,000	50	5	J. & J.	77
" "	Bds. 1902.	3,000,000	100	....	M. & N.	100½
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	.....
" "	Prf'd.	1,000,000	100	5	A. & O.	.....
" "	1st Bds.1930	6,000,000	100	....	J. & J.	.....
NEWARK, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	....	....	27⅜
" "	Bds. 1930.	6,000,000	100	5	J. & J.	84½
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	155
" "	Bds.	2,000,000	100	...	....	.....
PITTSBURGH—						
Duquesne Traction Co....... ...	Com.	3,000,000	50	...	....	25
" "	Bds. 1930.	1,500,000	100	5	J. & J.	100
Fed. St. & Pleas. Val. R. R.......	Com.	1,400,000	50	....	J. & J.	17¼
" " " " "	Bds. 1919.	1,250,000	100	5	J. & J.	100
Pittsb'gh, Aleg. & Man. R. R....	Com.	3,000,000	50	....		37½
" " "	Bds. 1931.	1,500,000	100	5	J. & J.	100
Pittsburgh & Birming. R. R.....	Com.	3,000,000	25	....	......	12½
" " "	Bds. 1929.	1,500,000	100	5	M. & N.	95
ROCHESTER—						
Rochester Railway Company....	Com.	5,000,000	100	...	....	67
" " "	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway..............	Com.	2,500,000	100	....	Q.-J.	72½
" "	Bds. 1910.	1,500,000	100	5	J. & J.	100
St. Louis & Suburban...........	Com.	2,500,000	400	....	....	30
Union Depot Railway...........	Com.	1,200,000	100	....	....	.....
" " "	Bds. 1910.	1,000,000	100	6	A. & O.	1

TRADE PUBLICATIONS.

La Revista de Electricidad is the name of a new electrical paper published at 30 Oficicos St., Havana, Cuba. It is a monthly Spanish journal, and is planned as an electrical review for extending the use of electrical apparatus in Spanish speaking countries.

The United States Investor has changed the size in which it has long been known and now appears in the handier size of 8 by 13 inches. New type and new paper give it a bright and fresh appearance. The Investor has earned an important position among the financiers of the east.

The Trade Press, a monthly publication in the interest of the trade and class journals of America, made its first appearance last month. It is published by Mr. Henry J. Bohn, one of Chicago's enterprising young men, and makes an auspicious entrance into this new field. The paper has a neat and attractive appearance and is carefully proportioned and arranged. The articles are well written by men experienced in trade journalism, whose ideas on the different subjects are of interest to the readers.

A pamphlet for the pocket has just made its appearance from the office of Lodge & Shipley Machine Tool Co., of Cincinnati, Ohio It presents in an excellent manner the many kinds of machinery manufactured by this company. The many styles of lathes and other tools for the machine shop are illustrated by numerous cuts. Numerous testimonial letters from users of Lodge & Shipley machines fill the pages in the back part of the book. The phamphlet is gotten up in neat and attractive style and should fulfill the object of its publication.

A catalogue and price list has been issued by Edward Lasell & Co., 225 Dearborn St., Chicago, of Monarch lamps, telephones and accessories. The Monarch lamp is shown in the various styles and the description is accompanied by the testimonials of customers. The telephones, switchboards and accessories are illustrated by cuts. The accompanying reading matter gives information regarding the use and installation of the telephone system. It is nicely gotten up, of vest-pocket size and places the subjects clearly before the reader.

Injectors, ejectors and other jet apparatus are illustrated and described in the recent catalogue of the Rue Mfg. Co. of Philadelphia. The many advantages of injectors over other machines and devices are set forth, and then the various styles of injectors are described. The company manufactures a number of styles adapted for locomotives, stationary and portable engines. The "Little Giant" injector in both the lifting and the non-lifting types have been in use many years, and have established through many severe tests and few repairs, its claims to special merit. Cuts show the method of attaching the injectors to boilers, and manner of operating. Other steam specialties are described in the subsequent pages and the catalogue closes with some general information.

Peck's Export Purchase Index makes its first appearance with the April number. It is published once in six weeks alternately in the English and the Spanish languages in the interest of the export trade of the United States. The editorial pages are full of interesting, instructive articles. The purchase index contains an alphabetically arranged list of the American manufacturers of articles possessing special points of merit for export, in connection with which the article list refers by number to the manufacturers of the given article. The work has been gotten up in an excellent manner. The press work and paper are of the first order and bring out the contents of the work. The plan of the publishers so well carried out will be found of great assistance by the foreign purchaser of American goods, while to the manufacturer it affords an excellent medium for placing his goods before the foreign trade.

"What Money can Earn and People Save, by means of the Harrison International Telephone," is the title of a catalogue issued by the Harrison International Telephone Co. The officers, directors and many of the prominent stockholders of the company, with a brief history of the company, are given in the opening pages. The telephones are leased to companies or individuals, no telephones being sold outright. The Harrison company agrees to protect the user in all suits brought for infringement. The exchange is free from all restrictions in the use of the telephones and pays but the stipulated rental per year. The Harrison telephone is an electric telephone and the patents on the exchange system, switchboards and appliances are owned by the company. The extensive line of valuable appliances controlled by the company places it actively in the field. Very clear cuts show the operation of exchanges, office and hotel telephone systems.

The trade catalogue of the Metropolitan Electric Company, which has been for several months in the hands of the compilers is just completed. It makes a volume of some 500 pages six by nine inches. It is very neatly bound with flexible covers, on which the name of the company is embossed in gold letters. Besides the list of supplies manufactured and handled it contains imformation for the guidance of purchasers. The telegraph code adopted is short, concise and easily used. The volume is fully indexed affording a ready reference to any of the goods listed. In the first part of the book wires and cables are listed, a most complete line of the well known N. I. R. make. The list includes everything from the silk braided cord to the heavily insulated, lead covered cable. Feeder cables, many circuited telephone and telegraph cables,magnet wire annunciator, tape, insulating compounds and textures are listed. The information accompanying the sizes of wire is complete in every particular. In tabulated form appears the list number, the size of wire, the area in circular mils, thickness of insulation, weight per thousand feet and price per foot. A list of connectors, binding posts and attachments used in the installation of electrical conductors, follows. Line and construction material, together with tools, etc., are carried in an endless variety. The styles of insulators and attachments shown include many recently designed. Another important line of goods is that listed under the P. & B. trade mark and for which the Metropolitan company is general agent. The goods include the standard articles for insulation which are in universal use. For electrical installations besides the specialties manufactured by the company the goods of standard manufacturers are listed showing an extensive variety for selection. The electric and combination fixtures shown by the numerous cuts are of especially neat patterns and the variety shown would seem to suit every taste and every place in which electroliers and brackets are used. The house goods have been well selected and are arranged with care. Instruments of every kind, for station, laboratory, etc., are shown together with an immense number of devices and supplies. The large amount of labor and expense expended in the production of trade catalogues indicates in a measure at least the important part they play in the transaction of business. The Metropolitan Electric Co. has spared no pains nor expense in the production of this catalogue.

PERSONAL.

Mr. A. L. Daniels of the Miamisburg Electric Company, Miamisburg, O., was in Chicago last month.

Mr. M. B. Austin, Chicago, is back from an extended trip through the east and south in the interests of the Knapp Electrical Works.

Mr. C. D. Crandall, manager of the Western Electric Company, has just returned from a trip of some ten days to Galveston, Tex., where he went for pleasure and recuperation. He reports having had a very enjoyable time.

Mr. David Chalmers has accepted the position of manager of the New York office of the Holtzer-Cabot Company, of Boston, Mass. Mr. Chalmers was formerly connected with and recently manager of the A. B. C. Company.

Mr. John Walker, until recently vice-president and general manager of the Walker Mfg. Co. of Cleveland, O., is to make Chicago his home, having accepted the position of general manager of the Fraser & Chalmer Co.

Mr. W. S. Louttit, assistant contracting agent of Pullman's Palace Car Company, recently returned from a flying trip through California and the west. While away Mr. Louttit paid a brief visit to the California Midwinter Fair.

Mr. James I. Ayer has accepted the position of general manager of the Royal Arc Electric Company and will remove to New York, where the main office of the company is located. Mr. Ayer is well known, having recently been at the head of the engineering firm of James I. Ayer & Co., of St. Louis, and formerly general manager of The Municipal Lighting & Power Company of St. Louis.

Lieut. E. J. Spencer, who was in charge of the affairs of the General Electric Company at the Worlds Columbian Exposition, has opened an office as consulting and contracting electrical and mechanical engineer at Security building, St. Louis. His experience in the engineering corps of the United States army and with the General Electric Company extending over several years, will be of great assistance in the new departure.

BUSINESS NOTES.

The Okonite Company, New York, is sending out a nice desk clock, with the compliments of the company. It is very neat and useful.

The Fibre Conduit Company, New York, removes its headquarters the first of the month to 257 Broadway, giving up at that time its offices at 45 Broadway.

The Hornberger Electric Manufacturing Company, Elkhart, Ind., reports that it has its factory at present working overtime in order to take care of orders for the Elkhart converter.

Cherry & Younglove, Syracuse, N. Y., recently furnished the woven wire dynamo brushes for the machines in the Cotton Exchange Building, corner of Broad and Beaver Sts., New York. It is said that excellent results have attended their use.

The General Electric Company has remembered its friends in the distribution of large doubled indexed diaries for 1894. Bound in morocco leather they are neatly gotten up, and of a size to meet the requirements of business men. Electrical Industries acknowledges receipt of one.

The Manhattan Construction Company, 50 Broadway, New York and 753 Monadnock, Chicago, has made arrangements with Mr. W. H. Fleming to act as selling agent for his patent woven wire brush. Mr. Fleming recently severed his connection with the International Trading & Electrical Company.

The New York State Electrical Co., Canisteo, N. Y., expects soon to start up the works purchased of the Malleable Iron Company at Youngstown, O., for the manufacture of electrical goods. The number of men employed in the works will be gradually increased from time to time as the plans are perfected of the new apparatus.

The Electric Storage Battery Company, Drexel Building, Philadelphia, has placed its Chicago business in the hands of Messrs. Pierce & Richardson, 527 Manhattan Building. The arrangements were made by Mr. Charles Blizard, the general sales agent of the company, while on a recent trip to Chicago and vicinity, introducing the Chloride accumulator.

The Chas. E. Gregory Co., Chicago, has just completed the purchase of the entire stock of Carpenter Heating apparatus and construction tools of the Ansonia Electric Co., together with 12,000 pounds of Shield Brand No. 14 wire. Business with this company is still good, a fact which is evidenced by the refitting of its offices and warerooms at considerable expense.

The Joseph Dixon Crucible Company, Jersey City, N. J., with its usual enterprise in meeting the wants of the trade, has placed on the market a chain graphite specially prepared for lubricating that class of machinery. For the use of bicycle riders it is put up in solid form for convenience in carrying. A protection is secured by the use of this lubricant from both wear and rust.

The American Hard Fibre Co., Newark, Del., a company recently organized for the manufacture of hard fibre goods of every description,is meeting with very flattering success, especially in the electrical field. The quality of the fibre manufactured is warranted to be equal, if not superior to, any fibre on the market, and at prices that are very low for first-class material and workmanship.

The Knapp Electrical Works, Chicago, have taken up the manufacture of electric street railway overhead material, and have already secured several large contracts for complete equipment. At present they report a large sale on Benedict solid copper railway bonds, for which they have taken the western agency. They have a complete catalogue of all their specialities now in preparation.

The Holtzer-Cabot Company, of Boston, Mass., now occupies the ground floor at 114 Liberty St., New York, with its New York office and salesroom. A full line of specialties manufactured by the company is carried. Under the able direction of the new manager, Mr. David Chalmers, the business will undoubtedly have a most prosperous season, notwithstanding the depression of past months.

Messrs. O'Regan and Segade, of Detroit, Mich., are placing before the trade a system of underground conduit for electrical conductors. The system is adapted for either insulated or bare conductors. That for bare conductors is lined with hard rubber. The system provides especially for the exclusion of air and dampness from the conduit. For lighting circuits, railway feeder lines, etc., multiple conduits are constructed.

Mr. James McLaughlin has sold his shop and electrical business with tools and good will of same to the Taylor-Belding Electric Co., and will open an office as electrical engineer, using the practical knowledge gained since the very inception of the electrical industry for the benefit of those who may require his services. Mr. McLaughlin retains his patents on arc lamps and dynamos and will push the sale of his commutator compound.

The Hoppes Manufacturing Company, Springfield, O., manufacturers of the well known Hoppes feed water heaters and purifiers, has secured the contract for feed water heaters and purifiers for the Municipal Electric Lighting plant at Detroit, Mich. The contracts calls for seven 300-horse power purifiers to carry 165 pounds of steam, working pressure. Each purifier is to heat and purify 9,000 pounds of boiler feed water per hour.

The Buckeye Engine Co., New York, is now occupying its new quarters at 39 & 41 Cortlandt St., having removed from 18 Cortlandt St. This company has furnished engines for many of the central stations and electric railway power houses of the country. Its engines are improved in design and construction and the new verticle engines designed for electric service will undoubtedly be appreciated by the electric lighting and railway industries.

Mr. W. H. Lahman after doing business for eight years at 158 Lake St., moves his offices the first of this month to 235 Fifth Ave., room 901. The Lahman grate bars are well known among steam users, their use being distributed over the country and the recognition they received at the World's Fair has increased their popularity. Flue cleaners of new design are being actively pushed in the market together with other boiler and engine-room devices.

The Electric Appliance Company, 242 Madison street, Chicago, in order to push the sale of the Packard lamp, has determined to carry a still larger stock of the several sizes in Chicago. The stock will be well assorted, running in sizes from 5 to 500-candle power. The large stock will enable them to take every order and guarantee immediate delivery. In the sale of general electrical supplies the large stock carried has always worked to the advantage of the company.

The Stilwell-Bierce & Smith-Vaile Co., has its Chicago headquarters at 63 So. Canal St. in perfect shape again after the repair and refitting necessary after the fire which damaged the building some time since. Everything about the place has a bright, fresh appearance, and Mr. F. H. Jones, the Chicago manager, has on display a new stock of steam specialties. To the regular list a large number of railway supplies have been added making the line of goods still more complete.

T. C. Rafferty & Co., 323-325 Dearborn St., Chicago, Ill., have recently closed a contract with C. J. Hirlimann, of New York, the well-known manufacturer of batteries, to represent him as exclusive western agents. The celebrated "Champion," the "Improved Porous Cup," and the "Original Disque," are among the best known batteries manufactured, and in their several spheres have no superior. The "Red Seal" porous cup for Leclanche battery has a very large sale, being used satisfactorily by many of the largest users of Leclanche batteries in the country.

The Stanwood Manufacturing Company, Chicago, has recently turned out from its shops some very excellent repair work that is worthy of mention. The special feature of this company's work is in the fact that it employs none but the highest skilled labor and it has special facilities for testing every piece of work before it leaves the shop. A certificate of test is attached to each repair job when shipped so that the customer may know that it has been tested for its requirements. The prompt shipment of work on the date promised is a motto of the company.

The Metropolitan Electric Company, 186-188 Fifth ave., report a large trade in porcelain goods, especially tubing for joist, varying lengths up to 40 inches being carried in stock. A number of large orders for N. I. R. wire have been received, among which was one for the wire for the new equipment of the Leland Hotel. The Stock Exchange building, one of Chicago's latest skyscrapers, adopted "Xntric" switchers throughout, placing a large order with the manufacturer, the Metropolicompany. The Old Colony building was also fitted with these switches. The P. & B. standard goods hold their own in the market, the company having a steady sale of these goods.

The Westinghouse Electric & Manufacturing Company has lately been awarded a contract by the Consolidated Railway Company of New Jersey for the year's supply of cars, from 300 to 500 in number. This will call for 600 to 1,000 motors. It has been found necessary to increase the night force in consequence. In addition, a number of small orders float in from day to day, affording more grist for the mill. Some of the heavy castings for the mammoth motors for the Niagara contract are nearing completion in the Allegheny shops, and it is said that the company will invite a private inspection of them. Double time is the rule in these shops. Its proximity to the chief source of supply of its requirements in iron and steel gives the Westinghouse company a distinct advantage over its competitors. The new plant at Brinton is being rapidly pushed.—Daily Financial News.

The Electrical Manufacturing Company of America, recently organized from the Gillett Electric Company, with office at 26 Cortlandt street, New York, and factory at Red Bank, N. J., start out with a number of large orders, among which is a contract for the electric banjos used in the United States. The instrument or machine, as it is of the "nickel in the slot" variety, is somewhat similar to the musical phonograph except that the music can be heard by every one without the use of a funnel. It is said that in the manufacture of this one device 100 hands will be constantly employed. The company makes a specialty of electrical novelties and devices. Among the standard goods made are magneto bells, telephones, fire alarm apparatus, sterilizing apparatus, etc. The new officers of the company are, president, W. J. Keys; vice-president and general manager, U. T. Fackenthall; secretary, Joseph F. Bray; and treasurer, Denis Fox.

Messrs. Cushing & Morse, 225, Dearborn St., Chicago, general western agents for Day's Kerite wires and cables, are renewing their acquaintance with the trade by the distribution of some 10,000 little envelopes containing plasters which the hard knocks of the past season may have made necessary. The package is very neatly gotten up. The well known trade mark of Day's Kerite occupies the place of the stamp, which is canceled with a fac-simile of a post-office stamp which, however, reads instead of the post-office "Order Kerite Wire." On the back the words "Stick to us and we will stick to you" occupy a prominent place. Under the head of directions are the following: For faulty circuits, first cleanse the lines by removing the old imperfect stuff and substitute Kerite insulated wire;" "For leaky joints discard everything else and use Kerite tape"; "To cure profanity use plenty of Kerite;" "To make a success of any installation use Kerite" and "For cuts and bruises use enclosed plaster."

The Watertown Engine Company, Watertown, N. Y., gives the following references for March: Detroit Foundry Equipment Co., Harvey, Ill., two 70 horse-power high speed automatic; Thackara Refrigerator Co., Philadelphia, Pa., one 50 horse-power high speed automatic; Waddell-Entz Co., New York, two 50 horse-power high speed automatic; Oxford Electric Light Co., Oxford, Ind., one 70 horse-power high speed automatic; Paulsboro Electric Lt. Co., Paulsboro, N. J., one 60 horse-power high speed automatic; Paulsboro Electric Lt. Co., Paulsboro, N. J., one 80 horse-power high speed automatic; Turner Building Co., St. Louis, Mo., two 35 horse-power high speed automatic; Frost Mfg. Co., Grand Junction, Iowa, one 60 horse-power high speed automatic; Adel Electric Light Co., Adel, Iowa, one 60 horse-power high speed automatic; Rockford Electric & Mfg. Co., Rockford, Ill., one 100 horse-power high speed automatic; Steamer "New York," Camden, N. J., one 150 horse-power high speed automatic; Southern Stove Works Evansville, Ind., one 100 horse-power slow speed automatic; F. C. Turner & Co., Mobile, Ala., one 75 horse-power slow speed automatic; S. L. Holt & Co., Boston, Mass., one 20 horse-power excelsior automatic; Cold Spring Sand Co., Tyrone, Pa., one 20 horse-power excelsior automatic.

The Chicago Rawhide Manufacturing Company, Chicago, is busy in its factory as usual. Mr. W. H. Preble, the secretary and manager of the company, states that he believes business in general to be improving although low prices are prevailing in many lines of manufacture. It is a matter upon which this company, however, is to be congratulated that it is able to maintain good prices in spite of the hard times—a fact which is no doubt due to the excellent quality of its goods. To its list of specialties the company has just added a new one, that of register and bell cords for electric street cars made in sizes from ¼ to 5-16 of an inch solid round rawhide. The value of such a cord will readily be appreciated by the trade as nothing is superior to rawhide for durability and reliability. The company has already had excellent success in introducing it among railways although but recently put on the market. It will be remembered that this company received an award of the highest kind at the World's Fair. The following is a copy of the award which speaks for itself:

UNITED STATES.
Department F—Machinery. 1690
Exhibitor—Chicago Rawhide Mfg. Co. Address—Chicago, Ill.
Group 69. Class 416.
Exhibit—Rawhide Belting.—

AWARD

Exhibits of Rawhide Belting, of Rawhide Rope Belting, and Rawhide lacing are highly meritorious.

The belts are from well selected stock of even thickness, soft and pliable when new; of good adhesion, and are in every respect well made.

The Twist Belting is made from three-eighths of an inch in diameter down to one thirty-second of an inch in diameter, and is of excellent uniformity and thickness. The leather is prepared without the use of lime or acids, the hair being removed by sweating.

Excellence in the production of Rawhide Belting and Lacing.

(Signed) Louis E. Reber, Individual Judge.
Approved: John A. Roche,
President Departmental Committee.
Approved: (Signed) John Boyd Thacher,
Chairman Executive Committee on Awards.
Date—March 5, 1894.

ELECTRICAL INDUSTRIES.

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The Department of Electricity, California Mid-Winter International Exposition.

The work of securing the apparatus and installing the electrical equipment of the Mid-Winter Fair was attended with many difficulties and discouragements. So much time was lost in securing the apparatus that it was necessary to crowd the construction work with all possible haste. In this the skill and ingenuity of the department was put to a severe test, and as evidence of how well it carried it through, one has but to look at the successful operation of the installation. The temporary character of the work and the apparatus secured, required the employment of special methods of construction which would be efficient and moderate in cost. The workmen took great pride in the work, and to that fact is due the thoroughness of the installation.

ELECTRICAL DEPARTMENT OF THE CALIFORNIA MIDWINTER INTERNATIONAL EXPOSITION.

The accompanying engraving is from a recent photograph of the department. The chief of the department, Lieut. W. F. C. Hasson, appears at the center of the group. A brief sketch of his life appeared in the January number of ELECTRICAL INDUSTRIES. His name has been familiar in the west for some time through his connection as consulting electrical engineer with a number of important enterprises and a member of a number of the technical societies of the United States. On his right is Mr. Sidney Sprout, and at his left Mr. Wynn Meredith, the two principal assistants of the department. Their connection with the department dates from the commencement of construction work. They were both connected with the electrical construction department of the World's Fair, and later with the operating department, and had previously an extensive experience in electrical construction work.

There also appears in the group Mr. Chas. A. Rosa, superintendent of the Western Electric Co.'s plant and exhibit; Mr. F. H. Dorr, in charge of the General Electric Co.'s exhibit; Mr. A. L. Croxton, superintendent of the Standard Electic Co.'s plant; M. Wm. Lawrence, in charge of the Ft. Wayne Electric Co.'s machines, and others in the operating department. The chief of the department has planned many special electrical displays which have given a variety to the evening illumination. These constant changes have kept the department busy, but have added much to the interest of the Fair. The work has been so divided that each has his prescribed duties to perform. The value of this method has been apparent since the Fair started in the absence of accidents and the excellent operation.

The larger part of the electrical energy generated is used for lighting and but the smaller part for power. The incandescent lights number 8,000, and arc lights 736. The power circuits are of 500 and 220 volts and furnish power for exhibitors in all parts of the buildings and grounds. The important features of the Fair are the Bonet tower with its electrical decorations and searchlight, the electric fountain and the Firth wheel, which is illuminated by electric lights and gives a fine night effect.

Annual Meeting of the American Institute of Electrical Engineers.

The eleventh annual meeting of the American Institute of Electrical Engineers was held at the Engineers' Club, Philadelphia, May 16, 17 and 18. The members were welcomed by Mayor Stuart and President J. C. Trautwine, of the Engineers' Club. Although Philadelphia and New York furnished a majority of the delegates, other eastern cities were well represented. The list of those present includes the names of many of the most prominent workers in this field. The subjects of the papers elicited interesting discussions, and marked interest was manifest in the entire program. Invitations were received at the Tuesday morning session to visit many points of interest in and about the city, which, together with the special entertainments that the hospitable Philadelphians provided, made the visit of all most enjoyable.

The reports of the secretary gave the present membership of the Institute as 800. The treasurer's report showed the income of the year to be $10,499.50; disbursements, $10,091.96, leaving a balance in the treasury of $407.54. The announcement of the tellers, Messrs. Upton and Metcalfe, showed the following list of officers elected: President, Prof. E. J. Houston; vice-presidents, W. A. Anthony, F. B. Crocker, J. Hamblet, P. H. Delany, H. Ward Leonard and W. Wallace; treasurer, George M. Phelps. The annual address was delivered by President Houston on a Review of the Progress of the American Institute of Electrical Engineers, a short abstract of which follows:

The American Institute of Electrical Engineers is in no sense a local organization. It has in view the interests of no particular section of country, but on the contrary is a national body. It represents the electrical profession in all parts of our great land, and welcomes into its membership bright and progressive men in the electrical profession wherever they may be located.

The first regular meeting of the Institute was held in Philadelphia, October 7th and 8th, 1884, in one of the exhibition buildings in West Philadelphia. From this small beginning our Institute has assumed its present proportions.

I think it would be difficult properly to estimate the good that has accrued to electric science, not only in this country but also in the world at large, from a properly organized association of specialists in a practical branch of science like that of electricity. If we can properly trace, from the circumstances attending a single electrical exhibition and series of conferences held in Philadelphia in 1884, a great awakening in the field of electricity, what must have been the influence for good, exerted by a body like ours, which I think I am correct in saying includes all the distinguished electricians in this country.

A glance at the transactions of the Institute will show the extended and valuable character of the work of its members. This work embraces notable inventions, extended commercial applications, and valuable researches, as, for example, researches in high frequency discharges; the development of alternating current apparatus for electric welding, and for the transmission of power; improvements in continuous current apparatus; improvements in the practical applications and control of electric motors for traction, mining, manufacturing and other purposes; improvements in telephony and telegraphy; improvements in the application of electricity to various chemical processes; improvements in designs for electric machinery; improvements in electric lighting apparatus of various descriptions, and developments in electro-therapy.

The work of the Institute as a body has also been of a broad and valuable character.

It may be advantageous here to review some of the advantages of membership in such learned associations, as for example, the Institute in which we are the most interested. Among the many advantages are the following: Concentration of effort; increased mentality excited by generous rivalry; systematic explorations into the domains of the unknown; a tacit agreement as to what shall be regarded as the standard of good work; the practical establishment of a practical high court of last resort by whom all disputed technical questions in electrical engineering shall finally be settled; the removal of electric work from the region of guess-work to that of certainty, permitting results to be as surely predicted as in other sciences, and consequently the increased stimulus to the successful investment of capital in electrical enterprises; the reduction of misdirected effort by the promulgation of information concerning what has been attempted or achieved in any direction; and, last but not least, the means of establishing a rapid intercommunication of ideas, between different parts of the country to others.

The session of Tuesday closed with the paper by Prof. W. A. Anthony on "Light Distribution and the Use of Lamps," in which he says:

Let us compare arc and incandescent lamps on the same basis, that the minimum illumination shall be the same under both systems. First, I must say that the efficiency of arc lights has been greatly overrated. Instead of being ten times, it is rarely three times, and often only one and a half times that of an incandescent lamp. This is for the naked arc. For indoor illumination, ground or opal globes are nearly always used, and those cut off fully half the light. This leaves the efficiency at the most 1.5 times that of the incandescent lamp. The power required for a 16 candle incandescent lamp is 50 watts, and for a full arc lamp 450 watts. The arc lamps must, therefore, replace nine incandescents. Assuming that the lamps are distributed as described in this paper, the table shows that if four arcs take the place of 36 incandescents, their efficiencies as compared with the incandescents must be 1.823, and with a relative efficiency of only 1.5, the arc lamps would not light the space as well as the incandescents. If 16 arcs take the of 144 incandescents, the ratio of the efficiencies required is 1.56, and arcs at 1.5 are still not equal to the incandescents. If 64 arcs take the place of 576 incandescents, the ratio of the efficiencies becomes 1.42, and arcs at 1.5 would be an improvement on the incandescents. It then comes to this, that unless the area to be lighted is so large as to require about 500 incandescents lamps distributed uniformly over it, the use of full arc lamps requiring the same power, will leave some parts of the area less brilliantly lighted.

If we could make small arc lamps of the same efficiency as the full arc—by full arc I mean the so-called 2,000 candle lamp consuming about 450 watts—we could improve somewhat upon the results as obtained above. But the fact that the mechanism of a small arc lamp costs just as much as that of a large one, and that *each* small arc will require as much care and attention as a large one, would place a limit upon the subdivision of the arc even if the efficiency could be maintained. And here I wish to enter a protest against the assumption that I often find in discussions of this subject, that the *so-called* 1,200 and 2,000-candle power arc lamps *are* 1,200 and 2,000 candle lamps. There is no 450 watt arc lamp in use that will measure 2,000-candle in the direction of greatest intensity, and compared with other artificial sources for great illumination, that is measured as other sources are measured, there is no 450 watt lamp that will give, when surrounded by a plain glass globe, 500 candles.

In a linear distribution, as in street lighting, the arc is at a still greater disadvantage. Remembering that nine 16-candle incandescent lamps can be run with the power required for one 450-watt arc, it is seen that the arcs must be nine times as far apart as incandescents consuming the same power, and to give the same minimum illumination must be 81 times as intense, or about 1,300-candle power. But in no arc lamp as used for street lighting, do the rays proceeding towards the most distant points to be illuminated, reach more than one fourth this intensity. In my way of thinking, the location of arc lamps at intervals of 1,000 to 1,600 feet, as they are often seen in pretentious country villages and suburban places, is an entire waste of money. A little spot 50 to 100 feet in diameter under each lamp is brilliantly lighted, while the more distant points are in darkness all the more profound from the loss of sensitiveness of the eye when in the strong light. Incandescent lamps at intervals of 100 to 200 feet, which could be run by the same power, would give a far better illumination.

Of course, in deciding between the use of arc and incandescent lamps in any special case, there are other questions to be considered besides that of the power required to operate. Practical questions of installation may outweigh all others. The consideration of these is foreign to this paper. The question I have considered is purely one of efficiency, and in treating that question I have assumed that every part of a space to be lighted, *needs* the same amount of light. I have admitted from the consideration all effects of reflection from ceilings, walls or reflectors purposely provided, as these are too various and depend too much upon the conditions in each special case to be introduced into a general discussion.

"WEDNESDAY'S SESSION.—"Some Storage Battery Phenomena," by Mr. W. W. Griscom, and "Discriminating Lightning Arresters and Recent Progress in Means for Protection Against Lightning," by Mr. A. J. Wurtz, occupied the attention of the convention during the morning. At the afternoon session Prof. Crocker presented a paper on "Unipolar Dynamos for Electric Light and Power." A type of such a machine was described and the necessary data given for its construction. The special features of the machine are its compactness, simplicity and its great strength and durability. "Alternating Currents and Fuse Wires," by Profs. D. C. Jackson and R. A. Ochsner, and other papers completed the afternoon.

THURSDAY'S SESSIONS.—"The Waste of Zinc in Open Circuit Batteries When Standing Idle," by Mr. Henry A. Lardner; "Standardizing Electrical Measuring Instruments," by Mr. Elmer G. Willyoung; "An Optical Phase Indicator and Synchronizer,"by Prof. George S. Moler and Dr. Frederick Bedell, and "A New Method of Recording Any Kind of Variable Current," by Prof. Albert C. Crehore, were discussed at the sessions of Thursday.

FRIDAY'S SESSIONS.—On the fourth day of the convention a number of very interesting papers were read and discussed, including paper on "Resonance Analyses of Alternating Current and Polyphase Currents," by Prof. M. I. Pupin; "Some Facts About Polyphase Motors," by Dr. Louis Bell; "The Law of Hysteresis and Calculation of Ferric Inductance," Mr. Chas. P. Steinmetz and "Experiments with Two-Phase Motors," by Dr. Louis Duncan. The sessions were well attended and the convention was considered by all a success.

Municipal Plant at St. Clair, Mich.

Many of the smaller cities of the country have anticipated their future needs in providing for the present need of a system of street lighting. While the present requirements are small yet favorable circumstances have enabled modern reliable installations to be made and operated economically. As a usual thing it is almost impossible to operate separately a small electric lighting plant at any thing like a reasonable figure per light, but the plant installed a few months ago at St. Clair, Michigan, of comparatively small size, gives every indication of a profitable investment. The plant was installed by the city in connection with its water works. An addition was put on the water works building for the accommodation of the electric light plant.

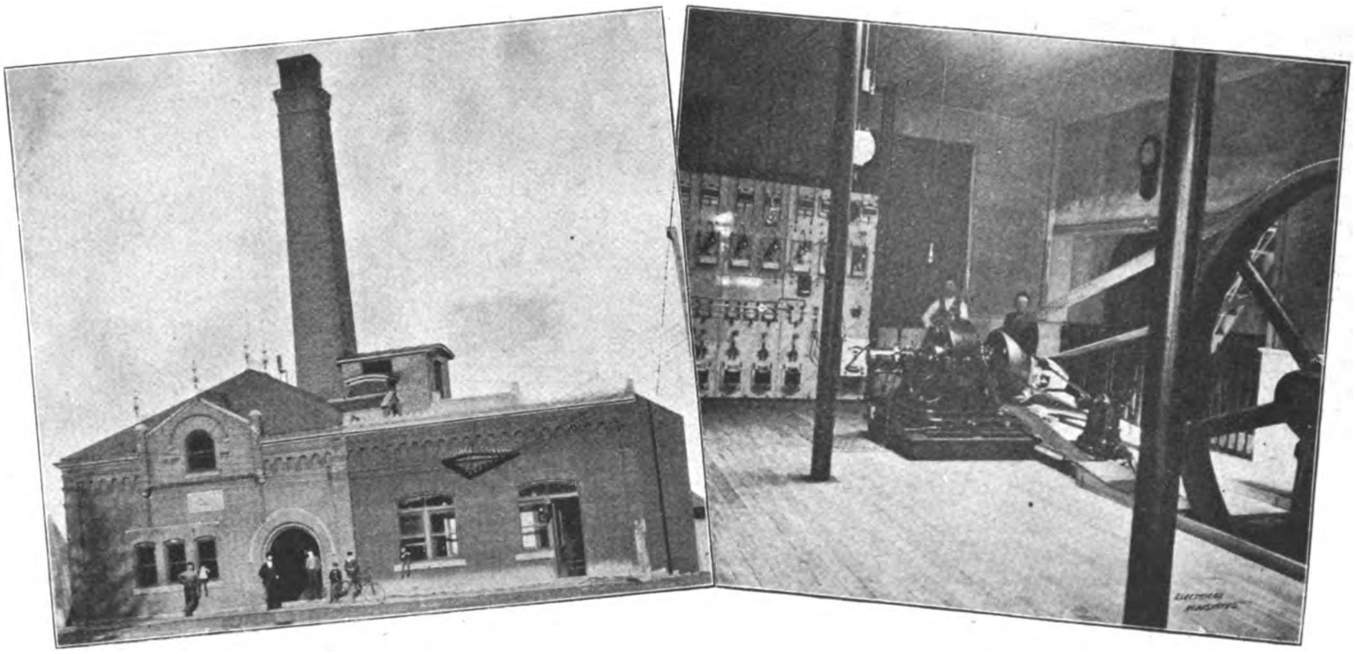


FIG. 1.—MUNICIPAL PLANT AT ST. CLAIR, MICH.

The city lighting plant consists of 31 all-night arc lamps suspended in the middle of the streets from 40 foot poles and the lights are distributed over the entire city, about eleven miles of wire being required for the circuit. The dynamo is of the Western Electric Company's manufacture and is a 40 light, high tension machine of the latest pattern, provided with reducing switches for 1,200, 1,800 or 2,000 candle power lights. The practice there is to reduce the candle power of the lights during the later hours of the evening when a better light is not required, and there is a consequent saving in fuel. The incandescent system consists of Westinghouse 45 K. W., slow speed alternating dynamo with switchboard apparatus. They have wired in a total of 425 lights on the incandescent system, 125 of which are in Congressman Whiting's residence. Incandescent lights are generally used by all of the merchants.

The switchboard is probably one of the finest boards that has ever been built for a central station. It is built of white marble, 1¼ inches thick and 9 feet square. The framework of the board is made of steel angle planed perfectly on its edges to secure a flat and perfect bearing for the surface of the marble slabs. On the face of the board are mounted two sets of bus bars for the incandescent machine, the idea being to put in a second alternating machine at a latter date. On this board there are mounted: Six alternating ammeters; one alternating voltmeter; six switchboard converters; six pilot lamps; six sets of double pole fuses; six double pole, double throw 1,000 volt switches; six double pole, single throw, 1,000 volt switches; 12 spring jacks for arc circuits; one arc ammeter and two pairs of 1,000 volt lightning arresters.

There are five alternating circuits run from the different parts of the city and two arc circuits, all of which terminate at the switchboard and each is provided with instruments to show the quantity of current in use on each line. The alternating circuits are connected in such a manner that should a second machine be put in place any one of the circuits can be thrown on either dynamo, or either dynamo may be run on either pair of bus bars. All connections for circuits are made on the back of the board, leaving the face free from all disfigurements such as would be caused by wiring running across it. The connections from dynamo to board are made underneath the floor with Patterson lead covered cable.

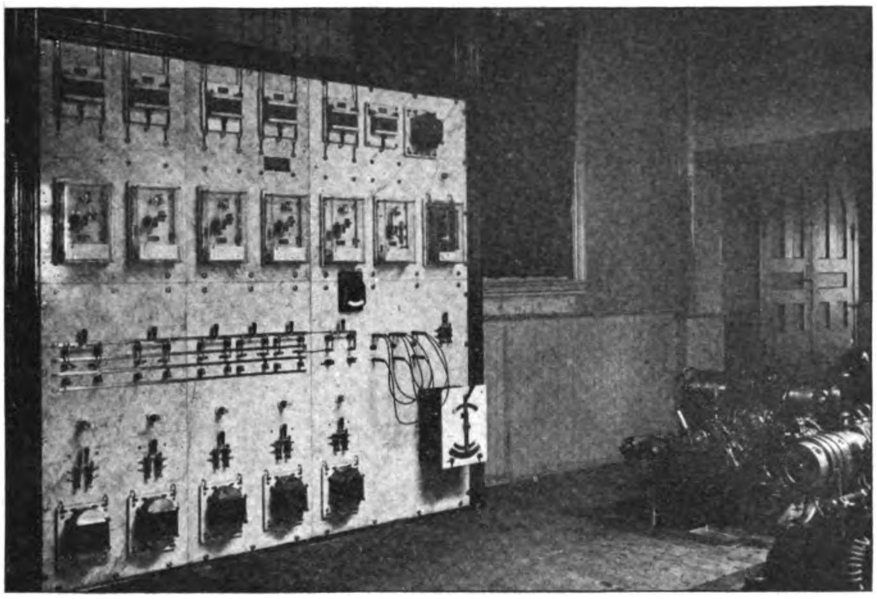


FIG. 2.—MUNICIPAL PLANT AT ST. CLAIR, MICH.

CLINTON E. WOODS.

The station equipment is complete is every respect and there has not been a detail neglected which will insure a more perfect service or convenience for the employes.

The pole line is built of 35 foot poles with 40 foot poles for lamp suspension. These poles are not less than seven inches in diameter at the top and are painted with two coats of drab paint with black bases and make a very neat appearance, special care having been taken to select straight poles. Cross arms are braced and corner pins used where corners are turned. The construction of the plant was specified in detail by the electrical engineer, Mr. Jesse M. Smith, of Detroit, under whose supervision the work was carried out. On the completion of the plant he pronounced it complete in every respect.

Where the circuits passed under the river it was necessary to use some submarine cable. 1,200 feet of this cable was required and was manufactured by the Western Electric Company—being of lead, covered heavily with No. 8 galvanized steel wire. The cables terminate on poles each side of the river in special junction boxes with fuse attachments. Should the circuits become grounded in the river the fuses will be blown on either side, cutting off the grounded circuit from the main circuit.

Up to the present time the plant has run without a hitch of any kind (having been completed in October of last year). It is under the charge of an Electric Light Commission appointed by the City Council of St. Clair, and is composed of Congressman Whiting, Mr. W. Jenks, P. S. Carleton, chairman and Chas. Hubel, secretary. It was under the business management of these gentlemen that the contract was made and the plant installed.

This plant was installed complete by the Western Electric Company, of Chicago, under the direction of Mr. Edw. Ellicott. We are indebted to Chas. Hubel, secretary of the Electric Light Committee for the following data of operation:

Number of incandescent lights in use	425.
Number of arc lights in use	31.
Amount of water pumped per month	13,000,000 gals.
Amount of coal consumed	55 tons.

The force necessary to operate the entire plant, both water works and electric light, consists of a chief engineer, second engineer and fireman. The plant is under the direct supervision and management of Mr. C. F. Grace, as superintendent, who reports each month regarding the plant to the Council. The total amount paid for salaries, both superintendence and engineers for the operation of the complete plant is $179.16 per month.

The plant is ably managed and operated on a first-class business basis and is a credit to the city. The above figures certainly prove that the plant has both been installed in an excellent manner and is being cared for and operated in a way that does not admit of adverse criticism.

Personal Sketch—Clinton E. Woods.

During the past year a number of new electrical machines and appliances have been placed on the market from the works of the Standard Electrical Co., of Chicago, which have shown in their design and construction more than ordinary engineering ability. Mr. C. E. Woods, the electrician of the company and the designer of this apparatus, is one of the younger members of this profession who has risen to prominence through perseverance and close attention to designing and the construction of electrical apparatus, aided by natural ability. The history of his career shows a struggle against adverse circumstances which were successfully overcome.

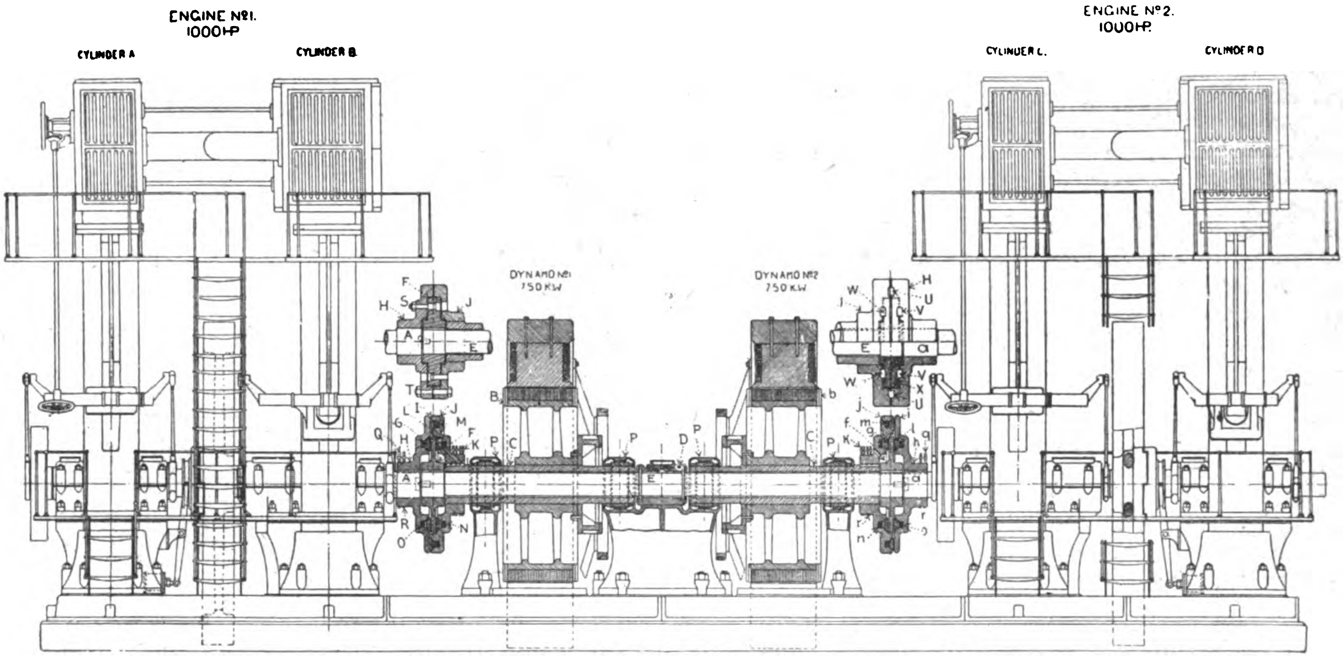
At 10 years of age he found himself an orphan in his native state, Massachusetts, and obliged to obtain his livelihood and education through his own efforts. Until 1886 he served in miscellaneous employments, when he drifted into steam and electrical work, for a time with the central station at Pittsfield, Mass., and afterwards at Peekskill and Newburg, N. Y. Up to 1889 he worked at general construction and engineering when he entered the employment of the National Electric Manufacturing Co., of Eau Claire, Wis., as its inspecting engineer and afterwards became electrician in chief. Early in 1893 he accepted his present position, where with the opportunity afforded he has shown his real ability. The line of arc, alternating and constant potential dynamos, motors, etc., and the necessary transformers and instruments designed by him, shows the breadth as well as thoroughness of knowledge. Many improved methods of manufacture introduced by him show also his ability as a manufacturer. The designs of electrical machinery show a neatness of outline and symmetrical proportions which are highly desirable from an artistic and mechanical standpoint. In his future work it is hoped that the high standard already established will always be reached.

New System of Engine and Dynamo Connections.

In designing a central station or power plant economy of operation is one of the first considerations, the varying load that the plant carries making it a difficult problem. The majority of the modern central stations are equipped either with a large number of small direct connected or belted combinations or the dynamos are belted to shafting which permits such a number as are desired to be operated at one time, the shafting being driven by either of two or both engines according to the load. In the system that has recently been designed by Mr. B. J. Arnold, who is well known in electrical circles, a great flexibility is secured while the plant is more compact and cheaper than present systems.

The accompanying cut shows the system as adapted for an electric railway plant of 2,000 horse power. The engines are cross compound of 1,000 horse power each, shown vertical although horizontal are as readily used. The armatures are free to revolve independent of the engines, being mounted on hollow cast steel shafts running in independent bearings. A shaft, carrying upon its ends circular cast steel discs securely keyed to the shaft, extends within these quills and is supported by the bearing at the center.

The drawing shows the engines connected to the generators by magnetic clutches which operate as follows: Attached to the end of the engine shafts, Aa, are circular cast iron or cast steel discs, Hh, carrying in recesses copper coils which are connected to brushes, Qq, by means of rings, Rr, in such a manner as to permit a current of electricity to be passed through the coils while the discs are in motion. Around the vertical face discs, Hh, carrying in recesses copper coil Oo, steel or cast iron rings, Ii, which are held in position on discs, Hh, by means of three gudgeons or bolts, equally spaced around the periphery of discs, Hh. Rings, Ii, are normally held against discs, Hh, by small spiral springs surrounding the gudgeons or pins. Attached to quills, Cc, are cast iron or cast steel discs, Jj, carrying two coils of copper wire, Mm, Nn, which are connected to brushes, Kk, so as to allow a current to be passed through the coils when the discs are in motion.



NEW SYSTEM OF ENGINE AND DYNAMO CONNECTIONS.

It will now be noticed that if a current of electricity is passed through the coil, M, a magnetic field will be created around it which will have a tendency to attract disc I, overcoming the action of the springs which normally hold it against disc H, and clasping it securely to disc I, so that power can be transmitted from one disc to the other by friction so long as the current travels through coils, M. If engine No. 1 now be set in motion, it will drive generator No. 1 directly connected, there being no wearing parts except what are ordinarily encountered in a direct-connected engine and dynamo plant. In like manner engine No. 2 can be connected to generator No. 2, thus forming two direct-connected power units.

Shaft E lies idle in bearing D, and is not used except in case it becomes necessary to drive either generator from the opposite engine, or both generators from the same engine. In a direct-coupled plant having but two units of power wholly independent of each other, in case the engine of one unit and the generator of the other unit should become disabled, the plant would be at a standstill, and unable to furnish any current at all. With such an emergency as this, this new system would operate without trouble, and should one entire engine unit become disabled, both generators can be driven from either engine by simply passing the current through the proper coils.

It will be further observed from the illustration that the main shaft of each engine is cut in the middle and the two parts are joined together by means of positive jaw clutches, operated by a steam cylinder. Thus when the load is light, say, from 12 o'clock till morning on an elevated road, engine and generator No. 1 are shut down. Cylinder D of engine No. 2 is cut off by means of the jaw clutch, and no portion of the plant operates except the high pressure cylinder of engine No. 2 direct coupled to generator No. 2. This cylinder can be run condensing and the plant operated with economy, until the road requires more power, when the low-pressure cylinder is brought up to speed and connected with the high-pressure cylinder without stopping the plant.

In case it becomes necessary to make repairs on the high-pressure cylinder of Engine No. 2 at the same time that the road is demanding the full power of engine No. 1, high-pressure steam may be admitted to the low-pressure cylinder of engine No. 1, which, as will be noticed from Fig. 1, is placed next to the generator. By working high-pressure steam in the low-pressure cylinder of this engine, it will give its full power, thus driving its generator and allowing the high-pressure side to be shut down for adjustment. Thus by having two engines with the high-pressure cylinder of one and the low-pressure of the other direct-connected to the work, the plant is arranged to operate economically with any load varying from 500 to 2,000-horse power, and it is practically impossible to shut down the plant on account of any accident that would be liable to happen.

In order to prevent wear on the rings of the magnetic clutches above described, the following method of electrically starting the generators is proposed under this system: Suppose engine No. 1 and its generator are operating and engine No. 2 and its generator are standing idle, and it becomes necessary to throw generator No. 2 upon engine No. 1, in order to repair something on generator No. 1. Instead of starting engine No. 2 to bring generator No. 2 up to speed, or allowing the friction of the magnetic clutch to bring the latter up to speed, the following method is adopted: Current being produced from generator No. 1 is passed through the armature and fields of generator No. 2 in such a manner as to make a motor of it until the armature attains the same speed as that of generator No. 1, when current is passed through coil on clamping disc f to disc j without wear on the clutch mechanism.

In case it ever becomes necessary to increase the capacity of the power station designed under this system, it is done by adding two more generators to the right of engine No. 2, having similar connections to generators Nos. 1 and 2, thus making four generators available from engine No. 2. The third engine is added as the power is required.

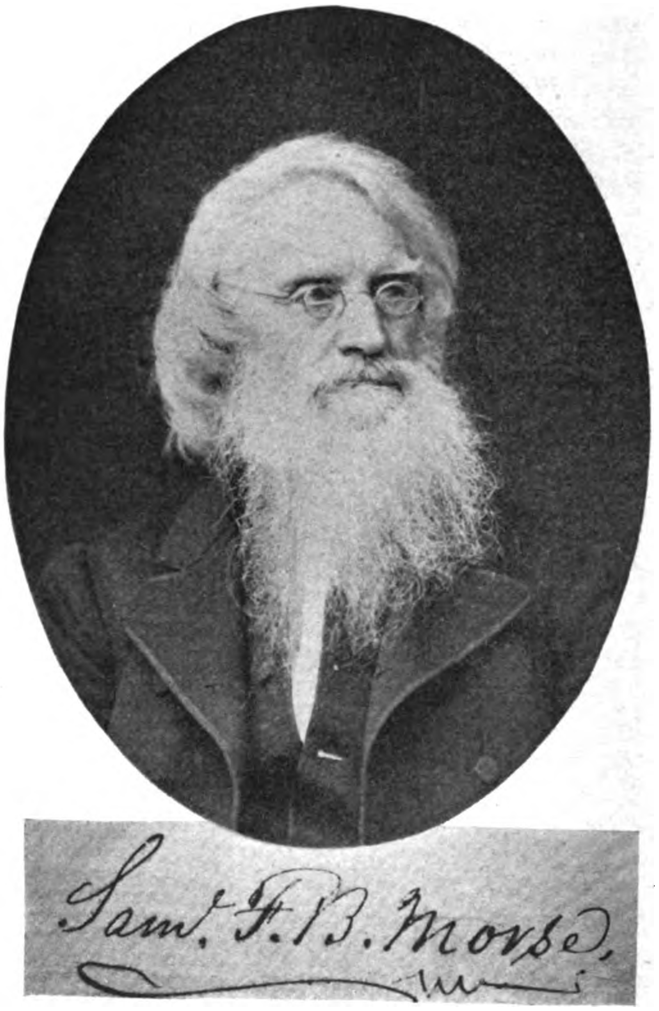
The magnetic clutches while convenient are not essential of course to the system's operation. Mechanical clutches may be used if desired; and for a railway plant, where the station can be stopped for a few minutes at the time of changing from one engine to another, could probably be substituted without detriment.

When it is desired to start any generator, it is brought up to speed as a motor, and when it attains the same speed as the line shaft, a positive clutch, operated either by hand or by electricity, is thrown into connection, after which the current is reversed through the machine and it immediately comes a generator.

It will thus be noticed that any generator in the plant can be started and stopped at will, without stopping either engine, or without using belts, pulleys or friction clutches, thus having all the flexibility and reliability of the ordinary low-speed lighting station, wherein shafting and belting are used, and occupying not over one-quarter the amount of real estate that such a plant ordinarily covers. This permits a very much less expensive building to be constructed, less investment in real estate; greater ease in operation on account of having fewer wearing parts to lubricate, and less labor to operate the plant.

The Telegraph and Its Inventor.

On May 24 occurred the fiftieth anniversary of the sending of that famous message, "What hath God wrought?" by the electric telegraph. A line had been constructed by government aid from Washington to Baltimore, and over this line that message was transmitted on May 24, 1844. This was considered the first practical demonstration of the invention. To estimate the value of this invention would be most difficult. It has bound the world together, made possible the daily press and the modern systems of business. Electricity in the industrial and commercial world dates from the above event. Since that day invention has followed invention until it seems to the practical man of today that the summit has been reached; and yet possibly the same thought came to those who witnessed the sending of the first message.



Saml. F. B. Morse.

Samuel F. B. Morse, the inventor of the telegraph, whose name is famous the world over, had the advantage of educated and wise parents, who directed his studies and whose counsels guided his conduct through life. He was educated at Yale college, graduating at 19 in 1810. His chosen profession was that of a painter. Under the best masters he studied in England, France and Italy. In 1813 his painting, "Dying Hercules," was placed among the 12 selected from those in the exhibit of the Royal Academy, London, and for a bust of Hercules he received a gold medal. This was his first success. His reputation grew rapidly and he executed many important commissions. A great disappointment, and one which even his later successes did not efface, was his failure to receive one of the commissions for the paintings for the capitol.

Inventors have come from nearly every walk of life, yet it is seldom that a person forsakes a calling in which he has attained prominence to enter upon the laborious duties of an inventor. Such, however, was the case with Morse. The field he entered was not unfamiliar to him. While at college he attended the lectures of Profs. Silliman and Day on electricity, and took great interest in the subject. In his studies and following the duties of his profession he added to his fund of general knowledge. He was a personal friend of Profs. Dana, Henry and others, who were experimenting with electricity. His inventive talent had previously manifested itself in many ways. Morse dates the invention of the telegraph from his voyage on the ship "Sully" from Havre to New York on his return in 1832 from Europe, where he had spent three years in executing numerous commissions and in study. It was suggested by conversation on the ship on the discoveries recently made in electricity. He spent almost the entire time during the voyage with his pencil, developing by means of drawings his system of telegraphy. The systems of telegraphy previously devised were limited to the distances the sight or hearing could cover, but his system was not limited by distances. Immediately upon his landing in New York he commenced the work of constructing his instruments. The history of the next 10 years is similar to that of other inventors. Without the means to perfect and to place before the public in a desirable way his apparatus, he was obliged to make his own instruments and at the same time earn his expenses until he secured, in 1837, the aid of Mr. Alfred Vail, who became his partner and valuable assistant.

After having exhibited his instruments before various scientific societies and prominent citizens, he determined to place it before congress. He set up his instruments in a room of the capitol and exhibited them to the president and members of congress, but it was not until February, 1843, that he succeeded in securing an appropriation of $30,000 to test the capacity and usefulness of the system. The line from Washington to Baltimore was determined upon as likely to prove the most beneficial. The wires were to be placed underground incased in lead tube, but after seven miles had been laid it was found that in the process of manufacture the insulation of the wire had in many places been destroyed. This plan was then abandoned and the wires were placed on poles. The work was prosecuted from both ends, and in May, 1844, the two parts were joined and the line completed. On the 24th the public trial took place. Two days later the National Democratic convention assembled in Baltimore, and the dispatches transmitted during the convention greatly increased the interest in the telegraph. All these dispatches were recorded on strips of paper, which was then considered an important part of the system.

For the operation of this line congress appropriated $8,000 and placed it in charge of the postmaster-general. Commencing April 1, 1845, a tariff of one cent for four characters was laid. For the first four days the revenue amounted to one cent; on the eighth day the revenue increased to $1.30. It was the intention of Morse and his associates to sell the patents to the government, and that the government would establish lines in connection with its postal system. In this he was not successful. In May, 1845, the Magnetic Telegraph Company was organized to build a line from New York to Washington, which was the first step in the establishment of the vast system that covers the civilized world. Prof. Morse received greater honors from the different nations than were paid to any American citizen. His life, which covered over fourscore years, closing in 1872, was full of activity.

S F. B. MORSEOF CHICAGO.

Many interesting souvenirs of the telegraph and its inventor are preserved by his grandson and namesake, Mr. S. F. B. Morse, of Chicago, who is identified with the electrical industry. For a number of years he was connected with the telegraph, and at present is a member of a well-known firm handling, in the west, insulated wires. Mr. Morse was a favorite of his grandfather, and retains a vivid recollection of many incidents and interviews with him.

What George Cutter Doesn't Know About Electricity.

BY PHINEAS BROADHEAD.

Thy correspondent, George, is extremely ready with his pen, and hath a brilliant imagination, and he alloweth his mind to ramble even as the lamb that skippeth on a thousand hills.

But thee can see that he stoppeth short, and carrieth not out the brilliant ideas which are the products of his mind-hatching. Why doth he cease to follow out the chain of thought he hath so boldly forged, when he saith, "The plant can then be operated all day and evening, the engine being merely placed in the path of the steam from the boiler to the heating system of the house?" Thee can see if thee stops to think, that the boiler house may be in the conservatory, and early lettuce and cabbages may be forced by its heat. Or if friend George desireth darkness and secrecy, why not cultivate mushrooms in the engine house, while experimenting on the "primary," or even the kindergarden battery?

In his European experience he has seen dog-power used to advantage. Why hath he not thought of that method of getting power? That power is dog cheap, and he would get it with the bark on—as my German friend would say, "by the pound."

There are plenty of inventors who will show friend George how to put in one horse power and take out two or three. The right bower of the worldly gamester may take two tricks, but it must needs be done by a lightning manipulator. Let him advertise in INDUSTRIES.

His statements to thee remind me of a friend's definition of the difference between instinct and reason. He said aloud in the meeting house that one of the creatures of God that hath reason knew what it knew; but one that had instinct did not know what it knew. And friend George saith he doth not know.

PHILADELPHIA, 5th mo., A. D. 1894.

In an address recently made before the Chambre Syndicale des Produits Chimiques in Paris, M. Berthelot proposes to utilize the central heat of the earth by sinking a shaft or shafts to a depth of 4,000 meters. At the bottom of these shafts he believes that a temperature of 160° to 200° Cent. would be found and the pressure developed could be used for running machinery. M. Berthelot believes also that at this depth we would reach a source of thermo-electric energy almost without limit.

Electrical Industries.

Entered at Chicago Postoffice as second-class mail matter.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

Advertising Rates upon application.

The subject of establishing communication with lighthouses, lightships, etc., has received considerable attention of late. A number of papers have been read before different scientific societies bearing on the subject in which the best methods of communication have been discussed. The difficulties of maintaining communication with lightships and isolated lighthouses have not, as yet, been overcome. The attention of the different governments has been called in this direction and it is hoped that experiments will be systematically conducted. With shore lighthouses and light stations, telephonic or telegraphic communications may be established and maintained by means of aerial wires, and the needs of the service would seem to be sufficient to require it. The British commission on electrical communication with lighthouses and lightvessels, recommends the establishment without delay, of electrical communication between the shore lighthouses and the telegraphic systems of the country. The committee expresses its regret that it is obliged to confine its recommendations in the report to shore lighthouses. The speedy destruction of the sub-marine cables on the rocks near the lighthouse and on shore, is one of the reasons that prevents the establishment of telegraphic communication with the isolated stations. The method devised by Mr. Chas. A. Stephenson of communicating with lightships, overcomes some of the difficulties, but the large amount of cable required increases largely the expenses of installation.

The destructive effects of electric currents on underground pipes and metal work, has been pretty thoroughly discussed since Mr. Farnham read his paper before the American Institute of Electrical Engineers. Tests of underground pipes show the presence of larger or smaller currents of electricity and a difference of potential from zero to 20 volts, and in some cases even higher. The effects of these currents are shown in almost every city in which the overhead trolley is used. It is quite certain also that many specimens preserved can attribute much of their corrosion to other causes, but enough reliable evidence is everywhere apparent. Since early in the history of the electric railway, efforts have been made to remedy this difficulty. Numerous changes in the system have been suggested, but probably the greatest advancement has been made in the matter of bonding. The later bonds used and the present attempt to prove that the welded rail will be a solution of the problem, will undoubtedly result in a great diminution of the disastrous effects. On many roads the practice of connecting the rails at various points to the water-pipes, etc., has also marked an improvement. Whatever methods are adopted, a portion of the current will still leave the rails and will pass into the earth according to the resistance of the return and the nature of the soil. In following pipes, bad joints and sections of greater resistance will cause the current to leap around those places and the effects of the current will be noticed at the points where the current leaves and enters the pipe. In proportion to the perfect conductivity of the return circuit to the generator the injurious effects of the wandering currents will disappear. Other systems are proposed in which a more perfect circuit is provided for. The three wire system and the double trolley system, each provide a remedy. The underground conduit system as used, undoubtedly provides a satisfactory system of electrical propulsion for thickly populated districts. A complete metallic circuit is provided that guards against injury to neighboring pipes or metal work.

The annual report of the Westinghouse Electric & Mfg. Co., that appears on another page of this issue, makes a very good showing for the past year, notwithstanding the condition of business in general. The work at the Fair was most satisfactory to all concerned and the company has obtained from the successful construction of the large plant and the large units a position which has already been found most valuable in securing important contracts. The work of the company at the Fair, and its exhibit, which was most complete in every particular, may well be considered one of the important events in the history of the company during the past year. The affairs of the company show a most careful management and an increase of earnings over those of the year previous. The satisfaction of the stockholders is probably best shown in the small attendance at the annual meeting at which less than a dozen were present, and at which the old board of directors was re-elected. The future of the company, as shown from the report, is most promising; the preparations for the new manufactory, with new facilities and improvements, anticipates the production of electrical apparatus at a greatly reduced cost. The contracts on hand and those in sight are most favorable to the success of the present year.

On another page of this issue will be found an account of the inaguration of a most important educational movement under the name of the National School of Electricity. The purpose of this school as announced in its prospectus, is to furnish local classes with a course in practical electricity by means of lesson leaves, reviewed by a local instructor and explained and illustrated with apparatus furnished for that purpose. The movement is timely and meets a demand which has for some time been apparent. There are thousands engaged in the various other occupations as well as those connected with the electrical industries who are desirous of securing just such a knowledge of electricity and its practical applications as this school proposes to give. It is an innovation, and its success is assured from the names of the honorary faculty and the business men back of it. It is founded upon a broad and philanthropic basis, the tuition fee being but nominal for the instruction given. Although but recently started, the work has already assumed considerable proportions in Chicago and vicinity, and is rapidly being taken up in other cities and will ultimately extend to every city and town of any size. The popular desire as well as the desire of mechanics and artisans for a more thorough knowledge of electricity is shown by the enthusiasm with which this plan of instruction has been taken hold of. Electricity has within but a few years become a most important industry, and as its field of usefulness has extended, the public has become more or less familiar with its applications, and it is the general desire to learn something more of its work that has given the impetus to this movement. The lessons are very carefully prepared so that they will be easily understood, but at the same time shall convey as complete a knowledge as possible of the subject. The course of instruction has been sanctioned by many of the most prominent professional and scientific men who have given their assistance in furthering the enterprise.

THE strike of the coal miners which covers almost the entire bituminous coal field of the United States, has affected almost every industry. It has occurred at a most inopportune time as regards business when the conditions are critical and trade feels more severely such disturbing influences. The inconvenience, suffering and distress occasioned by this strike have seldom been equaled and it is to be hoped that it will be brought to a speedy termination. Should it continue for any length of time, the disaster would be national in character. The causes of this strike have been obscured in the general ruin wrought. Although the miners had undoubtedly at the beginning a grievance, their violent and lawless actions have lost for them all claims to sympathy. By refusing to allow others to mine coal, preventing the movement of coal trains, destroying railroad as well as mine property, they have received the condemnation of all law-abiding citizens. That mobs of ignorant foreigners should control sections of the country, destroying property and murdering those who attempted to protect it, is a disgrace to the civil authorities and it is not to be wondered at that citizens of those sections should enquire if there is a government. Aside from the local features the situation is of national importance; that one industry can stop the wheels of every other industry and transform its thousands of workmen into idle and hungry men, should demand a remedy. The supply of coal in certain sections is almost exhausted and is being used in connection with anything combustible that can be secured. Railroads have diminished the number of trains, factories and power houses have shortened their hours, electric railways are looking over their old horse cars and stock, central stations are shortening their hours and economizing in every way. A speedy settlement of the differences that led to the strike, it is hoped will be made, and that business may again resume its usual course. A noticeable thing in connection with the strike is that Welsh coal is being imported at a fair profit under the present prices.

The past fifty years, during which the United States has taken rank as a mineral producing country, have witnessed a steady and rapid increase in the annual output of minerals. Its production of iron has increased in 30 years 11-fold and now places it far in the lead. These facts are indicative of the prosperity of the country and the substantial character of its industries. Financial storms and seasons of depression are but momentary in their effects and serve to sift out the chaff while disturbing only for a short time the more legitimate and substantial industries. The statistics that have just been compiled for the Mineral Industry by its editor, Mr. R. P. Rothwell, show that the mineral production for the past year is but little below that of 1892, notwithstanding the depression of the season. The most noticeable thing is the great decline in value which for the year amounts to over $79,000,000. Of the minerals used in the electrical industry the following table will show the production for the two years:

	1892.	1893.	
Platinum	350	300	troy oz.
Copper	163,000	162,000	tons.
Zinc	84,000	76,000	tons.
Lead	205,000	193,000	tons.
Asbestos	100	120	tons.
Mica	37½	37½	tons.

Bituminous coal shows a decline in value for the year of six million dollars and anthracite an increase in value of an output of four million dollars. The value of these statistics, published annually, is undoubtedly appreciated by every business man. The publishers must be commended for their enterprise in placing in compact form complete data on the subject. The amount of labor in gathering full and reliable information is little understood by those who have never attempted work of the kind. The volume which is now in the press is volume II, and gives in addition to the statistics of our own country those of all other countries. These volumes are published annually in connection with the Engineering and Mining Journal, which is devoted exclusively to the mining industry.

The Chicago & St. Louis Electric Railway.

Work on the Chicago & St. Louis Electric Railway, which was suspended last summer on account of the business depression, has been resumed. At the Chicago end work was started the first of last month at Alpine Heights, 20 miles from Chicago. It is the intention to build and put in operation the section of the road between Chicago and New Lenox as soon as possible. It is said that the rails and ties for this section are already secured, and as soon as two or three rights of way are secured the present force at work will be greatly increased.

Although modified in many particulars the plan of the promoters is still the original one. The speed of the trains is placed 100 miles per hour. The road will be standard gauge, double tracked and very nearly an air line from Chicago to St. Louis, which is 256 miles distant. Power houses are to be erected at points 50 miles apart and current transmitted 25 miles in each direction in accordance with a system which has been worked out with a special view to the service required.

The cars are low and long, mounted on two trucks of four wheels each. One motor is mounted on each axle, so that each car has four motors, and the entire weight of car and passengers will rest on the drive wheels, increasing the friction of the wheels. The current is conducted by means of an overhead trolley wire. It is also planned to establish a fast freight service, using cars similar to the ordinary box car, but mounted on special trucks with motors. These cars can be run single, coupled in a train or used to draw cars without motors. Six months is the time it is estimated to require to complete the line to Alpine Heights. As soon as the other sections are completed the whole will form a most direct line to St. Louis. The capital stock has been increased from seven to ten million dollars. The road is being constructed either under or over the highways so as to avoid all grade crossings.

At a meeting of the New York Electrical Society held at Columbia College on May 10th, Mr. W. S. Hadaway, Jr., delivered a lecture on "Electric Heating from the Engineering Point of View."

ODDS AND ENDS.

On the afternoon of May 5th the first electric car crossed the Mississippi river on the government bridge at Davenport, Ia. With the exception of St. Louis lines this is the only line south of St. Paul crossing the river.

Two years is the time allowed the Columbian Exposition Salvage Co. by the park commissioners of the city of Chicago to move the buildings and clear the grounds at Jackson Park. Work was commenced the middle of last month and the work will be steadily carried forward until completed. Everything that is of value will be preserved and sold.

Robert Hooke, the English physicist, is said to have discovered the transmission of sound over a wire in 1667. He says that, by the help of a tightly drawn wire which even might be bent in many angles, sound might be propagated to a long distance, and with a rapidity, which, though inferior to that of light was, at any rate infinitely superior to that of sound in the open air.

The Mid-Winter Fair was able last month to pay its revenue from admissions and concessions, its cost of construction and maintenance to date. The balance of the income will be devoted to a fund for placing the park in its former condition. The Fair is considered both by the many visitors and its promoters a great success. A number of plans are proposed for continuing the Fair after it is officially closed.

Ships passing through the Manchester canal which have not an electric lighting plant as part of their equipment are provided with a portable plant by a firm which makes that a business. These portable outfits may be obtained at either the Eastham Locks or at the Manchester Docks. The equipment consists of a combined engine and dynamo and a search light of the Admiralty pattern, having the power of 40 or 50,000 candles, enabling the crew to discern banks, buoys, locks, etc., three-quarters of a mile ahead. The same company provides portable equipments for boats while loading or unloading.

Some very beautiful electric lighting effects are to be seen at the Masonic Temple Observatory. The lighting is ingeniously done by very handsome lanterns in which are concealed the electric lamps. Prismatic and MacMonnies fountains with real water effects form part of a reproduction of the Court of Honor at the World's Fair, and make a very interesting scene. Two scenic theaters, in which are shown the imitations of "A Day in the Alps", are some of the other attractions of the observatory. Music is furnished by the Hungarian orchestra, and the whole comprises an evening's amusement which is thoroughly enjoyable. The Observatory is under the management of Mr. F. F. Gross and the electrical features have been installed under the direction of the electrician, Mr. C. D. Baker.

The work of constructing the wheel which is to be erected at Earl's Court Exhibition, London, is progressing. The wheel is built on principles similar to those of the Ferris wheel. One of the legs of the great tower supporting the axle has just been built by the Arrol Bridge & Roof Company of Glasgow. The wheel is to be 300 feet in diameter against the 250 of the Ferris wheel. The cars or carriages will hold 1,600 persons. The towers, which will be 175 feet high, will have on the top and at intermediate stages on either side, saloons, restaurants, etc., reached by elevators. The axle of the wheel is hollow and through the opening, which is seven feet in diameter, visitors may pass from one side to the other. The wheel is to be driven by two one and seventh-eighths inch steel ropes running around a groove near the periphery.

The industrial exposition that opened on May 5th at Antwerp for a period of six months, promises to be a success. The promoters of the enterprise are prominent citizens of Antwerp who in previous expositions have gained much experience. The position of the city geographically is most favorable, having communication by both land and water with the principal cities of the continent. It is situated on the river Scheldt about 50 miles from the sea. Although a city of but 275,000 inhabitants it is the distributing point for Holland, Belgium, northern France and northwestern Germany. It possesses facilities equal to those of any of the seaport towns of the continent as a distributor of goods. The exposition grounds cover about 120 acres and have been most carefully arranged. America is represented through the American Propaganda, which has erected a building and distributes as far as possible information regarding American manufactures. Models, catalogues and specially prepared literature form the principal part of the exhibit.

A system of suspended elevated electric railway has been invented by Mr. Lysander Johnston, an engineer. It is modeled somewhat after a suspension bridge and is constructed, briefly as follows: A series of suspended bents of 150 foot span supported by wire cables which are in turn supported at intervals of 150 feet by steel posts connected on top and across the track by a girder or truss. There is no wood in the construction, everything is of iron or steel. The rails are held in position by means of steel stirrups or yokes with horizontal top bars and vertical arms hanging from each end of the bar. The vertical arms at ends have inwardly and upwardly turned lugs on which the rails rest and to which they are bolted. The stirrups take the place of the cross ties on the ordinary railroad and are suspended from the wire cables by means of wire ropes at intervals of three feet on the line of the track. The car truck travels on the lower rails and are held by the use of guide rails. The car is suspended from the center of the trucks. Electricity is used as the motive power. It is said that such a road can be built, double track, and equipped for about $90,000 per mile.

Since the destruction by fire of the engineering laboratory of Perdue University on January 23d last, the work of restoring that part of the equipment of that university has been actively carried on through the efforts of the president and board of trustees, the requisite amount of money was secured for the buildings and equipment. The serious loss was a great blow to the institution but the completion of the present plans will place the institution in even a better position than formerly. The foundry and woodworking shop were damaged but slightly, which was soon repaired. The machine room, forge room and engineering laboratory which were destroyed will be completed by the 15th of this month. The engines and heavier machines have been shipped to the manufacturers for repair or to be replaced by new machines. The more delicate instruments are being replaced. The laboratory will, with the machines now being constructed, have unexcelled facilities for testing. A siding leads to the door from the L. E. & W. Rd. The Riehle testing machine, exhibited at the World's Fair, having a capacity up to 300,000 pounds, has been purchased, together with other machines and instruments of equal importance. Almost every type of engine in practical use is contained in the plant.

The National School of Electricity.

To its systems of education America is largely indebted for her commercial and industrial advancement. By the schools both public and private, abundance of periodical literature and the many ways in which information is scattered through the country, her citizens have been educated. It is truly said that no one who desires an education need be without one. The hardships often to be undergone, however, deter many who would otherwise secure an education. The lack of appreciation on the part of many, the anxiety of youth to become wage earners and the thoughtlessness of parents allow others to reach mature years without the education which is then difficult to secure. In order to place within the reach of all, old or young, the popular reader or the mechanic, the means of securing a thoroughly practical knowledge of electricity, the National School of Electricity has just been organized and a prospectus issued.

Of the sciences that recent years have given us, electricity stands boldly in the fore ground. Its importance commercially and in the industrial arts makes it one of the most valuable forces of nature. The complexity of the systems in use and the laws that govern their operation have mystified the ignorant and puzzled those who have not had the advantage of a thorough education. The quickness with which it has risen in importance has made it a most interesting field of study. To the popular reader or those whose education was completed some time ago, this new science with its new phraseology, has been impenetrable and the attempt to learn something of it has ended only in a confusion of meaningless words and references to to laws and principles to which the reader was equally unfamiliar. To those desiring a general education as well as those placed in charge of power plants or by whom the power systems of factories and shops are controlled, together with that army of engineers and artisans which has risen with the growth of this industry, a knowledge of electricity is a necessity. In every branch of industry the intelligence of the workman is increasing and in this later industry, intelligence and some knowledge of the fundamental laws of electricity is necessary. It is a most difficult thing for the uneducated boy to enter the factory and by continuous application to his bench become finally the superintendent, although such a thing may happen. Some men with extraordinary powers of application have educated themselves, but to succeed by this means requires a quickness of intellect and perseverance not often found. The many technical schools place each year in the field hundreds of trained men in competition for the higher positions, while the artisan who has acquired his knowledge and training in the shop finds himself barred for the want of an education, although of sufficient intelligence and possessing many qualities which would otherwise fit him for the position. This school, by a comprehensive method of instruction, places within the reach of all a course of electricity which involves the fundamental principles of the science, a thorough knowledge of the practical side of the subject and an excellent foundation for advanced work if such is desired.

THOS. A EDISON.

NIKOLA TESLA.

ELISHA GRAY.

The causes which led to the founding of this school are best described by the following extract from the prospectus: "During the progress of the World's Fair the chief of the department of Electricity received hundreds of letters from all parts of the country suggesting, in many cases urging, a course of lectures on Practical Electricity in connection with the department. As the great Exposition neared its zenith the letters and appeals became more urgent in tone, and the chief of the department enlisted in the cause many of the experts in charge of exhibits. A small auditorium in the Electrical building was devoted to the undertaking and the lectures were begun. By the time the third one was delivered the attendance became so great that the seating accommodation was entirely inadequate, and the dissatisfaction on the part of those unable to secure admittance grew so outspoken that the lectures had to be discontinued, no larger hall being available. The subject was not allowed to die, however, and the chief was besieged more strenuously than ever; and after the Fair was over the appeals took the form of a demand for a permanent substitute. In obedience to this demand the chief of the Electrical department has secured the co-operation of the ablest men in the electrical profession, and in so far as may be the original undertaking will be carried out in a permanent and necessarily modified form."

Since the close of the Fair work has not ceased in the effort to perfect the permanent organization of the school. In preparing the course of instruction, both the eminent educators whose names appear in the list of the faculty and also others who are widely known as instructors, have assisted. The plan of instruction provides for the organization of local classes in the various cities and towns, which will meet once each week at some centrally located place, a method that will make the study both interesting and instructive. The lessons will be issued each week in the form of leaflets, which will contain, besides the lesson for that week, a review of the lesson of the previous week. Drawings and illustrations will accompany the leaflets, of such kind as will give a full and thorough knowledge of the subject. Only those things will be taught which have received the sanction of scientific authorities. From the elementary principles and facts which underlie the science the course of instruction will lead the student by easy stages up to a full knowledge of modern practices. Technical language, mathematical formulæ and everything that would be likely to confuse the student is omitted, and only such terms will be used as the student has learned in previous lessons. The course of instruction is, therefore, within the reach of all and requires no previous training.

It is not contemplated that the National School of Electricity shall in any way compete with, or be in opposition to, the electrical departments to our colleges or the excellent facilities of our technical schools. It would be unwise to think that the magnificent training secured by a three or four years' residence at one of these schools could be duplicated by any other means. This school of electricity offers a substitute for a college training to the thousands who have not the means or opportunity to enter college, offering to all a course of instruction which will not conflict with the daily employment, but give to the leisure hours a means of improving the mind, broadening the faculties and fitting the student for a higher field of employment. The method of teaching combines the best of several systems. It is most difficult for any individual to pursue a line of study by himself, and the assistance secured by correspondence is not all that is desired. Many things come into the student's mind that it is hard to wait for the mail to answer, and often the answer to one question brings up many other difficult points. Talking over the subject with others serves to fix it in mind, and what one fails to get hold of another will. The presence of the instructor at the weekly meetings gives an opportunity to ask such questions as the students are unable to answer. A system of examinations will be conducted at regular intervals, and at the end of the course a certificate will be issued. The tuition fee is nominal, and it is the intention to set aside a certain portion of it as a scholarship fund for the purpose of giving deserving young men the benefits of a college education, the selection to be made by competitive examinations.

W. A. ANTHONY.

H. S. CARHART.

J. P. BARRETT.

The faculty of the school is as follows:

Thomas A. Edison, Dean; Nikola Tesla; Prof. Henry S. Carhart, Professor Electrical Engineering, University of Michigan; Dr. Elisha Gray, A.M., Ph.D., LL.D., Highland Park, Ill.; Prof. Harris J. Ryan, M. E., Associate Professor of Electrical Engineering, Cornell University; Dr. F. A. C. Perrine, Professor Electrical Engineering, Leland Stanford Junior University, Palo Alto, Cal.; Prof. William A. Anthony, Ph. B., member American Institute Electrical Engineers; Prof. George D. Shepardson, Professor Electrical Engineering, University of Minnesota, Minneapolis, Minn.; Prof. Michael T. O'Dea, M. S. E. E., Professor of Applied Electricity, University of Notre Dame, Ind.; Prof. Brown Ayres, Professor of Physics and Electrical Engineering, Tulane University, New Orleans, La.; Prof. Dugald C. Jackson, C. E., Professor of Electrical Engineering, University of Wisconsin, Madison, Wis.; Prof. Benjamin F. Thomas, Professor Electrical Engineering and Director of the Physical Laboratory, University of Ohio; Prof. J. P. Barrett, Chief Electrician for the city of Chicago.

It would be hard to select a body of men whose names are better known in the electrical world or whose qualifications would better fit them to occupy that position. The school has secured the co-operation of the best authorities on electrical subjects and the ablest instructors among the educators of our land. There is no part of the school but has been provided for; the company has been incorporated to facilitate the business part of it and sufficient funds have been secured for conducting the work of the school. Books, papers and lessons leaves will soon be off the press ready for the classes now being organized. The offices of the School are located at 1427 Monadnock Block, Chicago, where all correspondence should be addressed.

At the present time there are nine classes organized in Chicago, of from thirty to seventy-five members each. These classes meet one evening each week under the direction of an instructor who is thoroughly familiar with the subject by virtue of a college course and a practical training. The support that has been given the school by the prominent men of the city has been all that could be desired. Bishop Fallows, who is widely known, gave his influence in behalf of the school by presiding at the meeting for the organization of the first class. The management of the Armour Institute has aided so far as the organization of a class in the Institute, which will be under the personal direction of Prof. Stine. The organization of classes in other cities has also been undertaken. The lessons, drawings, papers, etc., which are prepared by some member of the faculty and approved by all, are now coming from the press and the active work of the school is being carried forward.

The New Headquarters of the Central Electric Co.

For many years the telegraph, laboratories and a few special applications of electricity were the sole consumers of electrical apparatus. The manufacture and distribution of these goods was then of but trifling importance. With the invention of the electric lighting systems and the application of electricity to the transmission of power, it grew rapidly until it is now one of the most important industries.

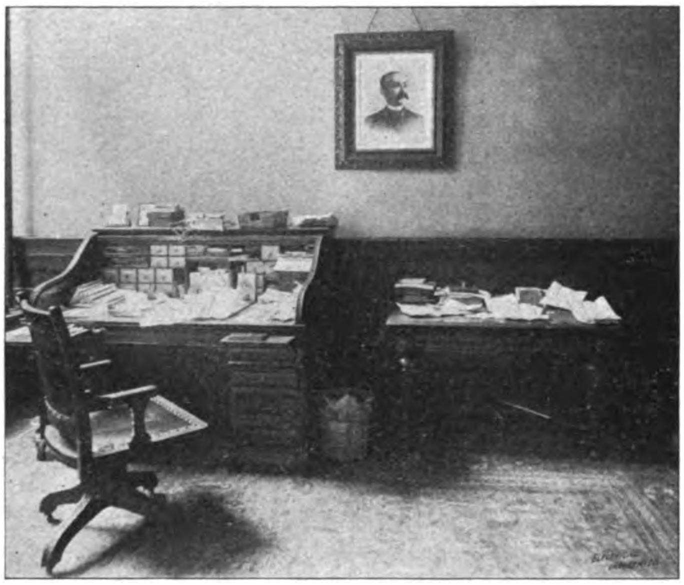
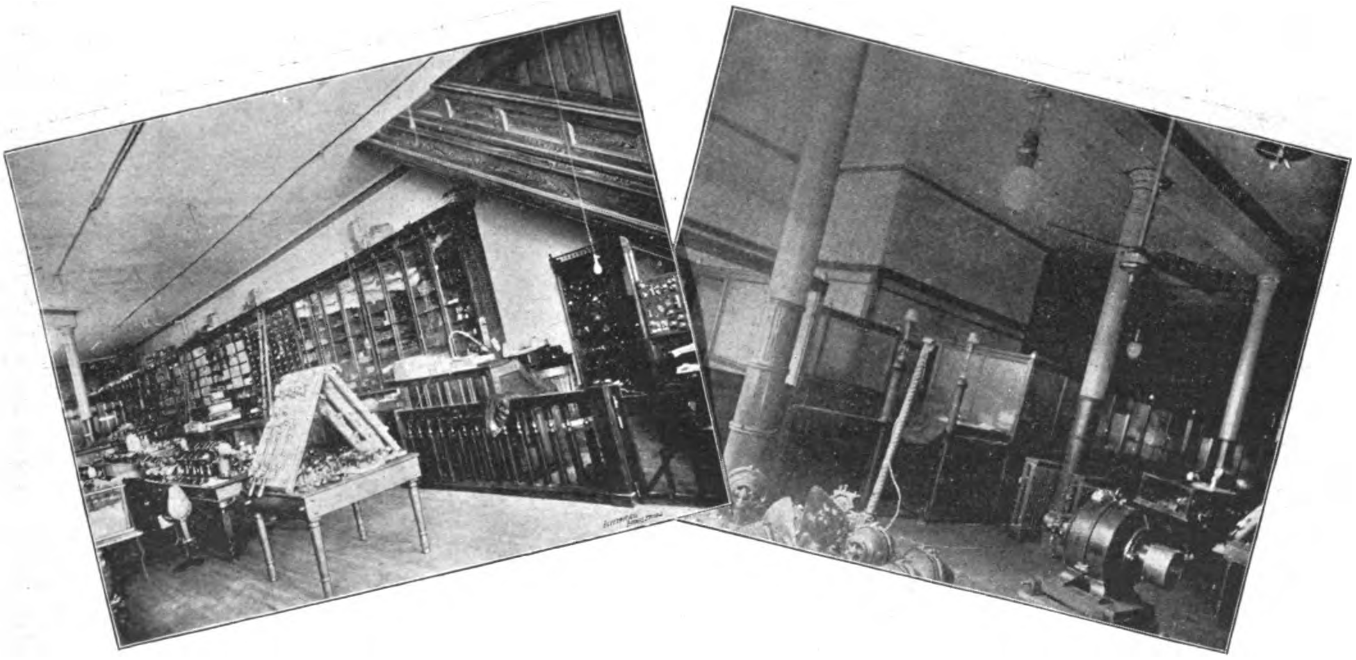


FIG. 1.—THE NEW HEADQUARTERS OF THE CENTRAL ELECTRIC CO. —PRESIDENT'S OFFICE.



FIGS. 2 & 3.—THE NEW HEADQUARTERS OF THE CENTRAL ELECTRIC CO.—SALESROOMS AND OFFICES.

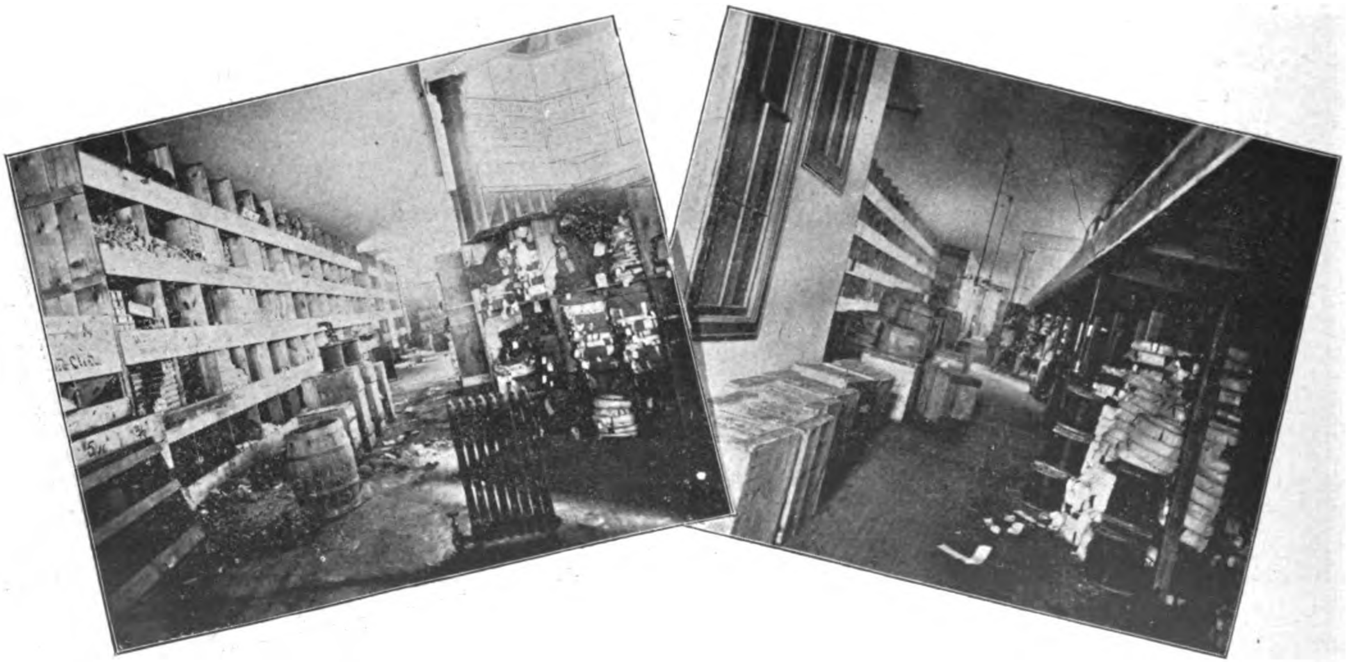
Houses that handle electrical apparatus and supplies are standard institutions of every large city. Success and failure have attended the efforts of the founders of the industry as in other lines of trade. The rapidity with which many electrical houses have risen to positions of prominence is indicative of the wisdom of the management and the careful business methods pursued.

One of the best known electrical supply houses is that of the Central Electric Co., which, through the admirable systems of communication Chicago affords, has built up a trade that covers not only the extensive Mississippi valley, but the extreme western and northern portions of the United States. The constant and substantial growth of the business has necessitated several removals since the company was organized, but the present quarters are unexcelled in the facilities afforded and the elegance of its offices and salesrooms. The salesrooms occupied by the company at the time of its organization, in 1887, were small and located on the second floor at 38 and 40 La Salle St. In 1888 the

MR. GEO. A. MCKINLOCK.

company occupied three floors and basement at 42 La Salle St., but after two years these were found inadequate, and in January, 1890, the company moved into the more extensive building at 116 and 118 Franklin St., which has since become famous as the headquarters of electrical supplies. With a constantly extending field of trade and a more thorough acquaintance with users of electrical supplies the company outgrew even this building during a residence of four years.

MR. CHAS. E. BROWN.



FIGS. 4 & 5.—THE NEW HEADQUARTERS OF THE CENTRAL ELECTRIC CO.—WAREROOMS ON SECOND FLOOR.

After a careful inspection of the business district and an examination of the many offers of owners and real estate men, the building at 173 and 175 Adams St. was considered the best adapted to the wants of the business. This building was formerly occupied by the Edison General Electric Co., and more recently by the General Electric Co. After several weeks spent in remodeling the building and to fit it for the transaction of business, the Central company on April 15 took possession and now occupies this building. It is expected, although it is now filled by the offices and the extensive stock of the company, that the accommodations will be ample for many years to come. The location is most convenient from all parts of the city; it is only a few steps from the different cable lines. With respect to the depots and freight houses, the location is central, as it is also in respect to the business part of the city.

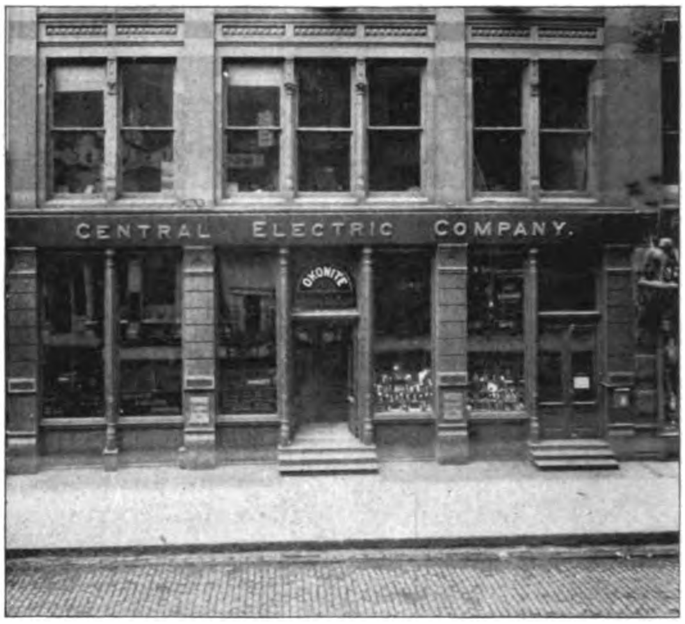


FIG. 6.—THE NEW HEADQUARTERS OF THE CENTRAL ELECTRIC CO.

The building has a large floor space, and accommodates on the ground floor the offices, salesrooms and shipping department. The offices are immediately at the left of the main entrance, while the salesoffices are at the right. Sufficient room is also afforded the display of many of the finer grades of goods in the showcases and sample tables. For the fixture department a room is also being fitted up on this floor which will contain sample fixtures of the various kinds. The shipping department occupies the rear of the main floor, where the alley gives room for the trucks to unload and load. The elevator is so placed that goods from the different floors may be loaded directly from the elevator on the trucks. The offices, besides being light and commodious are elegantly fitted up. Every modern convenience for the transaction of business is found in these offices. The president's office, while affording the desired privacy, is not so secluded but that easy communication is had with the other offices.

By a skillfull apportionment of the duties the officers of the company are fully informed of every transaction. Each of the different departments is in charge of an experienced salesman who is a valuable assistant to the trade in being able to furnish information respecting anything in his department. A thorough knowledge of the latest practices and recent improvements enables him to give distant customers any information of this character. Each is posted on the methods of manufacture and the conditions of trade in his particular line, a great advantage in securing prices on goods and permitting figures to be quickly given on contracts for apparatus or supplies.

One of the standard commodities handled by the company is Okonite wire, the name of which is closely associated in the west with that of the Central company. That brand of insulated wire has long been looked upon as the standard, and millions of feet have been sold by this company. It is used for every class of installation, whether for the fire-proof skyscrapers of Chicago or the frame suburban cottage. It is specified by architects and the immense stock carried is an indication of the large demand. The basement of the building is used entirely for the heavier articles and a large part of it is filled with insulated cable and heavy wire bearing this brand. The lighter wire is stored in the bins on the second floor which is divided into two stories, as shown in the accompanying illustration for handling the wire more conveniently.

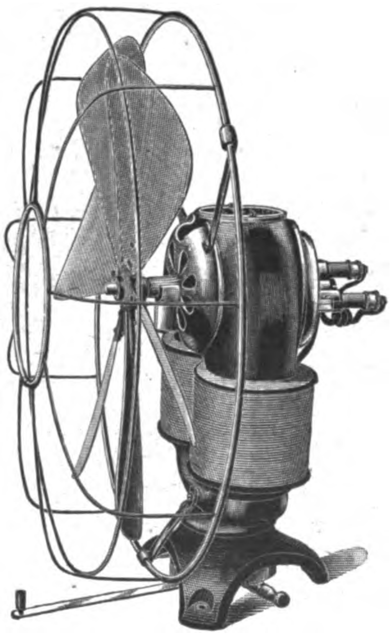
Interior conduit, which since its introduction a few years ago has become a favorite with all who wish a good insulated and protected system, is also handled in large quantities by the Central company which is the exclusive agent. The sales which at first were confined to the local trade now extend over all sections of the country. It has been approved by the National Board of Underwriters and is the only complete system of wiring. This department is in charge of Mr. Chas. G. Burton. In order to illustrate the method of interior conduit wiring a sample installation has been placed on the main floor showing the use of the system. The conduit used is of the brass covered style put up with fittings of the same kind. It gives a very neat effect and shows how the system is used for incandescent or arc lighting, for electric power circuits, etc.

The motor department is in charge of Mr. W. H. Huddleston, and comprises motors for every kind of service. At the present time the great demand has been for the Lundell fan motors which, on account of their many good qualities, are general favorites. The flexibility of the hangers and standards permitting them to be turned in any direction is appreciated by users. Telephone and telegraph supplies and line material occupy a large amount of space. This department has during the past year filled a number of especially large contracts. The house goods department, which includes hotel and office electrical goods, is in charge of Mr. W. R. Pinckard. The line of annunciators, bells, batteries, etc., is most complete, and includes almost every style made. The storerooms are fitted up so as to facilitate the shipment of the goods. The specialties are kept in bins reaching from the floor to the high ceiling, and are quickly packed for shipment.

A description of the store, however brief, would be incomplete without mention of the president and general manager of the company, Mr. Geo. A. McKinlock. Mr. McKinlock is one of the successful young men of the present age. His business career has been almost entirely in connection with electrical pursuits, and his earlier connections most valuable in conducting the affairs of his company. As district manager of the American District Telegraph Company, he gained a thorough knowledge of the telegraph; later as cashier and auditor of a telephone company at Detroit he acquired a knowledge of telephony; then his experience with the Detroit Electrical Works added a knowledge of the manufacture and distribution of electrical apparatus to his store. In looking for a broader field for the exercise of his business ability, the advantages that Chicago offered were at once recognized and he was instrumental in the organization of the Central Electric Company. Since Mr. McKinlock came to Chicago his prominent connection with the commercial side of electricity is too well known for further comment. His business ability is shown in the success of the Central company which has advanced to the foremost rank under his direction. The secretary of the company is Mr. Charles E. Brown, who has been connected for several years with the company. He was formerly associated with some of the prominent business houses of the city, and has therefore had an extensive business experience, admirably fitting him for the many responsibilities of his office.

Roth & Eck Fan Motors.

The accompanying cut shows the one-eighth-horse power fan motor manufactured by Roth & Eck, of Chicago, fitted with a 12-inch fan. It has a neat, symmetrical appearance, and is nicely finished. They are japanned with nickel plated trimmings. The bearings are self-oiling and are perfectly clean, and no oil will drip or be thrown from them. The armature is of the Gramme ring type, with windings so proportioned as to give a maximum efficiency. The brushes are simple carbon pencils held in adjustable holders, and are easily replaced at trifling cost. The commutator is made of gun metal segments, insulated by mica strips. The motor is mounted on a tripod swivel base, and can be easily turned in any direction. The guard that covers the fan is made of heavy, stiff brass wire, and is firmly attached to the field casting. By means of a small switch the speed of the fan may be regulated from 2,000 to 1,400 or 800 revolutions. It requires but very little current to operate the fan. As the warm weather comes they will be found a very pleasant part of the office equipment or that of the home.



The Johnson-Lundell Electric Railway System.

To perfect a system of operating street railways that would have all the advantages of the trolley system without either the defects of the overhead or underground conduit systems, has been a problem which has received the attention of engineers for a number of years. An immense number of patents have been taken out on supposed improvements on present systems and systems which envolve entirely new principles.

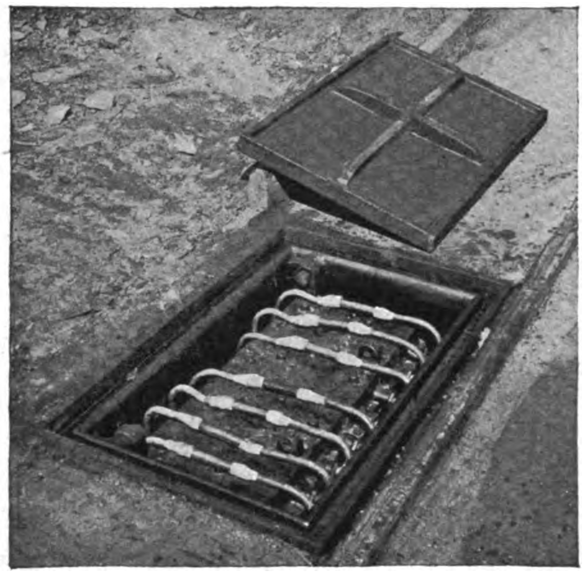


FIG. 2.—THE JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

We illustrate herewith the experimental road in New York City upon which the Johnson-Lundell system has been tried. The track runs around a whole city block, with grades and difficult curves. The power-house is at the foot of the hill and at the center of that section of the track or circuit. The generating plant comprises a vertical engine driving directly a pair of Lundell dynamos, the unit being such that it could be enlarged on exactly the same proportions up to any size for any road. Its capacity here is far beyond the need, but serves admirably to illustrate the manner in which the generating part of the Johnson-Lundell system is provided for.

The track itself is of ordinary construction as to the rails. Between the rails it is asphalted or paved—examples of both are shown—and paralleling the rails lies a conducting bar or strip of metal embedded in the asphalt. This bar is level with the surface, and is divided up into sections with insulating blocks of stone or other material between them. Just outside the single track, or midway between the double tracks, are plain boxes with iron covers flush with the street surface. In these boxes are substantial electro-magnetic devices which deliver current to each section as the car comes along, and then lie quiet until the succeeding car rolls up. These switch-boxes are water-tight, and may be compared to automatic switchmen. Each box governs its particular sections of track. The car carries a pick-up rubbing brush which leads the current into the motor and which takes the place, or fulfills the function of the trolley pole wheel. There is one great difference, however. The trolley system is alive throughout. This is not alive anywhere except at the point over which the car is passing. The difference of potential between the two sides of the circuit between which the car moves is practically nothing, hence there is no danger to horse or passer-by.

The car has but one motor. This motor is central under the car and drives on each axle by means of bevel gear, and with sprocket wheels and link chain in flexible connection with same. Its suspension is flexible, the bevels are boxed, the sprocket wheels and links mesh noiselessly. The motor is, moreover, iron-cased and protected against dirt, stones, moisture, etc.

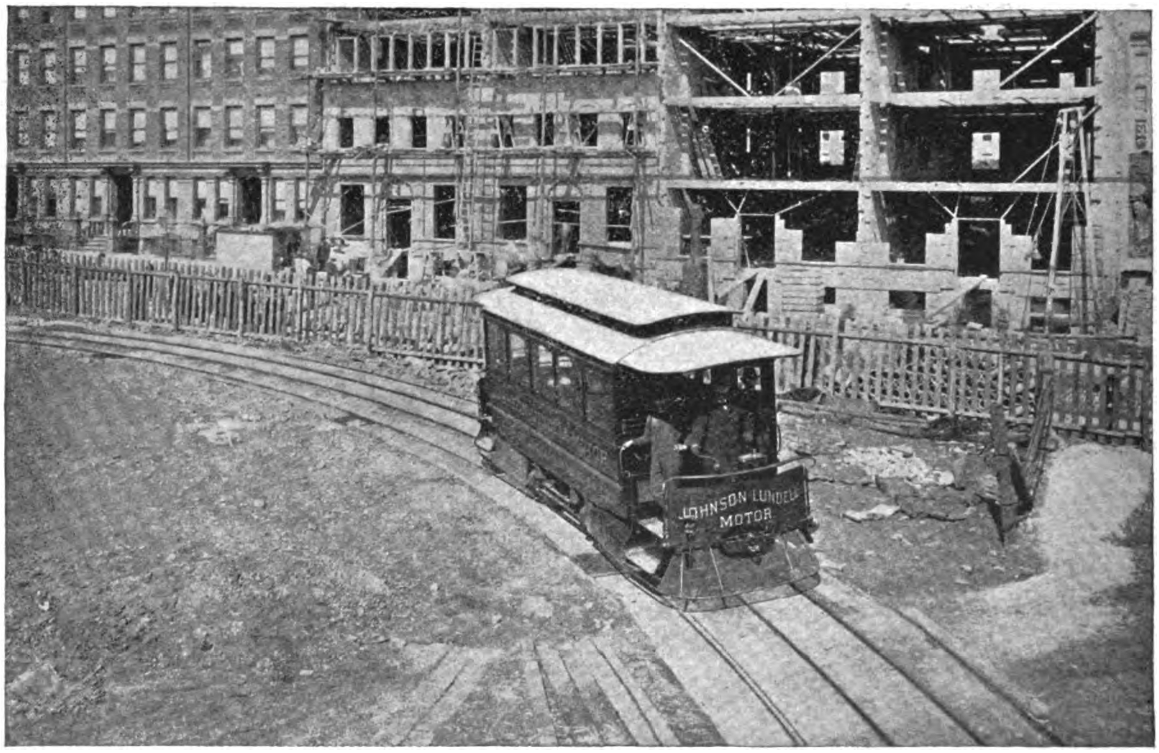


FIG. 1.—THE JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

Underneath the car is a steel brush which gathers up the current and passes it up into the motor, the return being as usual through the rails, which are obviously harmless, as the conducting strip between them is only alive when a car is right over it. But the car is not dependent merely upon the supply of live current. Under the seats are frames holding a very simple, elementary form of lead storage battery, enough to furnish the voltage at which the motor runs—300 volts—and though with very few plates in each cell, giving considerable capacity. The batteries are always in place; they need no change, practically no attention, but at a moment's notice they furnish current and can carry the car through many emergencies. The batteries play one or two parts in the internal economy of the car—"picking up the circuit" for a second when it starts; lighting the car; but their great beauty is that they render the car at once self-contained and dispense with the usual costly, complicated and troublesome wiring at crossings, switches, steam-railway tracks, etc.

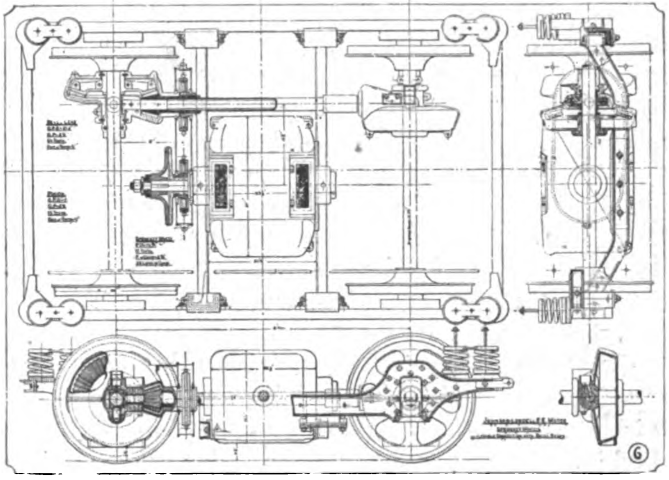


FIG. 3.—THE JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

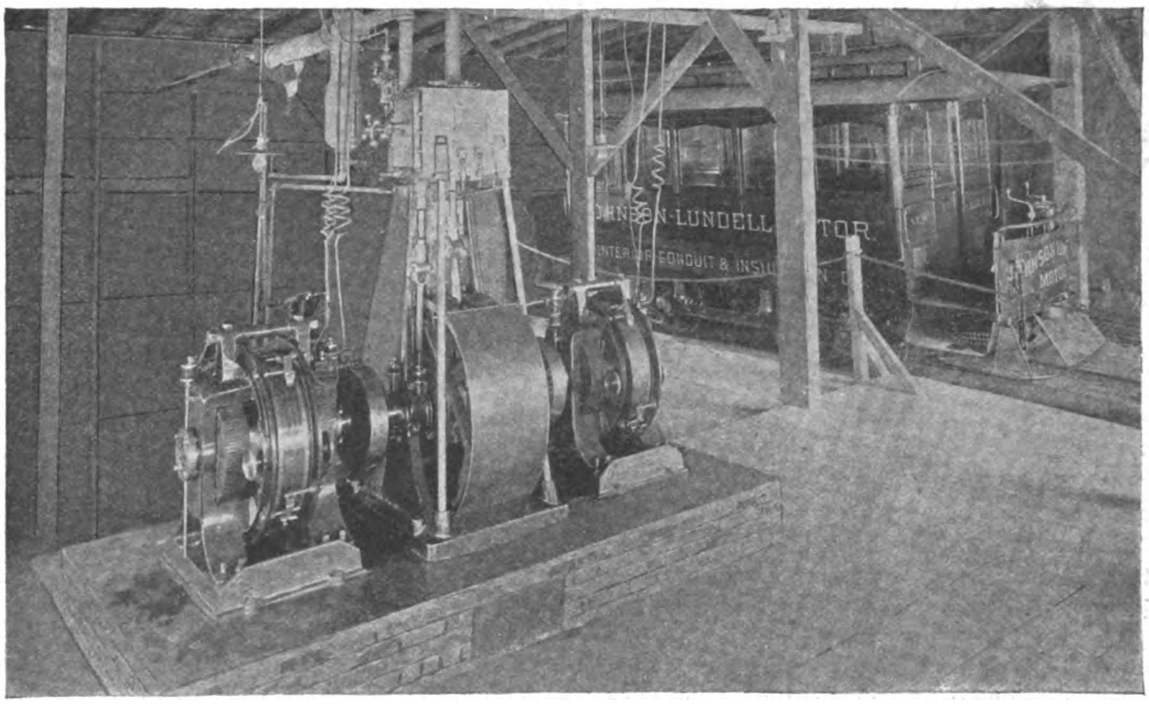


FIG. 4.—THE JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

To install the system well involves a liberal expenditure, but the outlay is small compared to that for the cable system, and on practically equal terms with that of a well built trolley road. There is no deep excavation, there are no poles to set, no overhead wires to maintain, no trolley poles and wheels to renew. The conducting strip along the track does not scrape away in any perceptible degree, and the steel brush will perhaps wear to a stub after many months' use. The magnet boxes have nothing to wear out except strong little contact jaws, and the iron tubes are a solid protection to the feeders. On the cars the gears are liable only to the usual wear. The battery is under the most favorable conditions. Another feature is that each car has its single set of batteries and does not have two or three other relay sets lying around a large central power-house to be charged, occupying time and space and attention. What charging these batteries get is given them out on the road while the car is at work.

In the Johnson-Lundell system there is but one motor under the car to make any noise, and the pick-up brush does not give any vocal sign at all of its presence. The other moving parts are the magnet armatures in the switch boxes, but one can listen a long time with ear to the ground over them without detecting a sound. It is remarkable that a car should be able to travel so fast and so heavily loaded as does the Johnson-Lundell with so little disturbing noise.

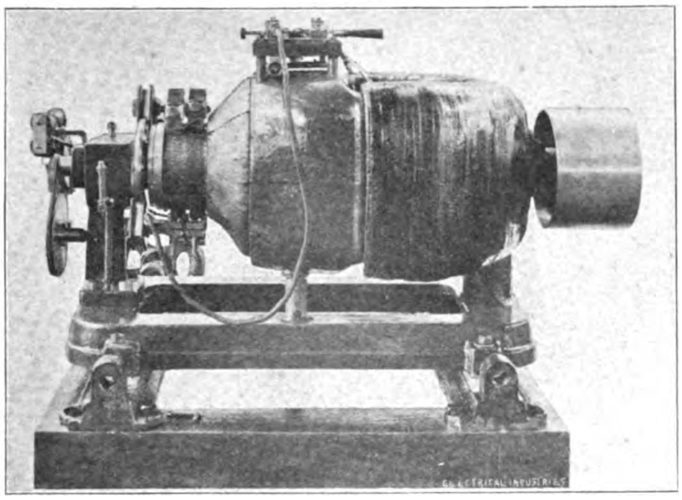
Except for the presence of the little central strip between the ordinary street car rails, nobody would ever know that an electric system had been introduced. There are no networks of wire; no long raking rows of poles, no unsightly jumble of guys, pull-offs, etc., at crossings. We see simply an ordinary track, plus a strip that one would not notice unless attention were directed to it. Evidently such a system is not only easy of adoption or adaptation but one that can readily be extended. It must always be remembered that a trolley car is dead if but two or three feet from its wires which supply it with current. But the Johnson-Lundell car is never cut off from motive power and best shows its advantages when the emergency is greatest.

It is reported that a method of smelting iron by an electrical process has been devised by Mr. G. de Laval, and the first practical installation on a commercial scale is to be placed at Trollhattan, Sweden, where an immense water power is available. Mr. de Laval is also the inventor of the steam turbine that bears his name and which has attracted a great deal of attention.

The Bain Arc Dynamo and Regulator.

The accompanying illustration shows one of the latest types of "constant current arc light" dynamo and regulator, the invention of Mr. Foree Bain and manufactured by The Great Western Manufacturing Company, of Chicago. The field is horse shoe shaped, the core being cast in one piece. The armature is of the Gramme type, large in diameter with numerous independent coils. The regulator is said to be very sensitive, very positive in operation and will maintain a constant current independent of the number of lamps in circuit. The brushes or collectors are of carbon, so placed as to produce a constant lap on the commutator.

The automatic regulation is performed by the movement of the brushes around the commutator. The motive power for operating the regulating device is secured for a large pulley which is belted to the end of the armature shaft. In the rotation of this large pulley the rachet bar is reciprocated; this rachet bar carries a small rachet, which is held out of engagement with the rachet wheel by means of two eliptical springs on either side of the armature placed between two pair of electro magnets. The rachet wheel is connected by means of a shaft, not shown in the engraving, to a small pinion which engages in gearing cut on the rocker arm which carries the brushes. The directing device, shown under the connecting board, which is mounted on top of the dynamo, consists of a small iron bar suspended immediately over the armature. This director controls two contact devices, shown on the top of the connecting board, the said contact device operating to short circuit both electro magnets when the machine is working under normal conditions and is producing a current at which it has been adjusted.

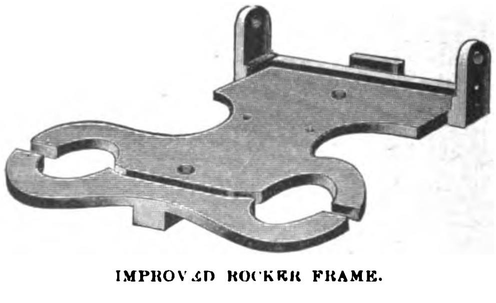


THE BAIN ARC DYNAMO AND REGULATOR.

The thumb nut, on the right hand side and just below the connecting board, illustrates a means of adjusting the value of the current while the machine is in operation; this thumb nut is connected by means of a bar and a spiral spring to the director bar, and tends to hold it in a position opposite to the position that the bar would assume by an increase of current in the armature. The operation of the device is as follows: When the machine is first started the spring connected to the controller pulls the controller-bar into position approximately parallel with the path of the current circulating in the wires of the armature. When the current in the armature has assumed a given value, which has been predetermined by the tension of the spring, the deflecting bar is deflected from a line parallel with the current in the armature to a line slightly at angle therewith. Before it has been deflected, however, to the position described, the contact above the deflecting bar has been opened by the deflecting bar being out of position it assumes when the machine is operating under normal conditions, an open contact above allows the current to pass through a pair of electro magnets, on the right hand side of the armature, situated between the two pair of electro magnets. The current circulating in this pair of electro magnets attracts the armature towards them and engages the rachet device in the rachet wheel and quickly gigs the rachet wheel, in this case, in clockwise direction, which moves the brushes to a point on the commutator corresponding to the highest potential. If the external resistance is such that the current may be maintained with a lower voltage than the maximum of the dynamo, the current tends to rise above its normal value and the director is deflected to a still greater angle, which causes the contact controlling the electro magnets, on the left-hand side of the electro magnetic armature, to be closed and at the same time, or possible a period later, the contacts controlling the electro magnets, on the left-hand side of the armature, are opened, allowing the current to pass through them and they attract the armature, which causes the double rachet to engage in the rachet wheel in such a way as to cause the rachet wheel to move n an opposite direction from that just described, by the means of which the brushes are moved forward on the commutator to a point where the E. M. F. is just sufficient to maintain a constant current through the resistance contained in the circuit. When the machine is operated through a circuit which is substantially unchanged the brushes remain quiet and the only moving device is the crank wheel and the reciprocating bar, which holds the ratchet, as the rachet is held out of engagement until one or other pair of the electro magnets are energized. The director device may be adjusted at any time while the machine is operating so that it will maintain a constant current at any value desired within a range of 20 per cent of its rated capacity, that is to say, it may be adjusted to deliver a current 20 per cent larger or 20 per cent smaller than its rated capacity. The machine is very substantially constructed; it has self-oiling bearings, is self contained, no outside devices being necessary.

Improved Rocker Frame.

Something new and of special interest to users of T-H arc lamps is shown in the accompanying cut, which illustrates the improved rocker frame manufactured by Campbell & Co., of Kalamazoo, Mich. It is a device invented by Mr. S. L. Campbell of the above firm, who after using the device for a long time with good success decided to patent and manufacture it. Wherever it has been used, time and money have been saved in repairs and Mr. Campbell claims that with this rocker frame the T. H. arc lamp is as economical to repair as any on the market. It is simple in construction and will not easily wear out. After having been tried by a number of central stations it has been adopted throughout.

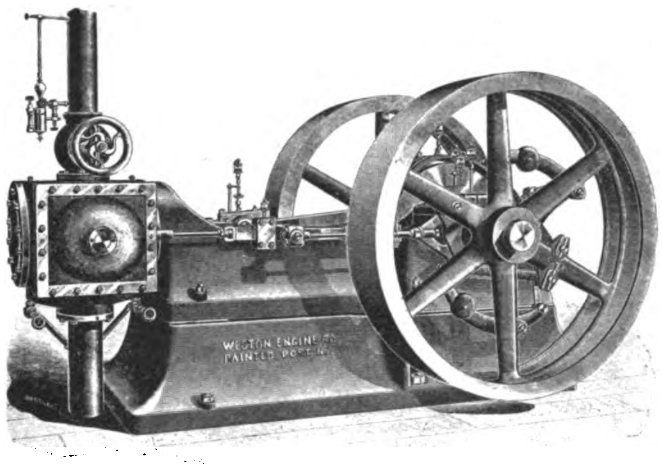


IMPROVED ROCKER FRAME.

The Weston Automatic Engine.

For central stations and power houses of electric railways or transmission plant where close regulation and high efficiency are most important factors, the Weston automatic engine has been found well adapted. Where conditions demand a reduced speed, a medium-speed engine with longer stroke is built by the company. The demands of the trade are fully met as regards speed, and in other directions the following description will show the qualities of the engine. The most noticeable features of these engines is their heavy, substantial appearance. Though the different parts are heavy, the engine is well proportioned and gives every indication of great durability. The moving parts are well supported on large bearings, which are provided with stationary, sight-feed, oil cups. The main bearings are of the quarter-box type, with an adjustable cheek piece to take up wear, and a cap made adjustable with liners. The cross head is adjustable to accommodate wear and is so constructed that the piston rod cannot get loose after being once fastened.

The cylinder, which is a separate casting, is attached to the bed by studs. A cast iron jacket filled with mineral wool prevents condensation. The steam chest is closed steam tight by cover without gasket. The valve is a single casting with accurately parallel faces. By recessing the pressure plate to correspond with the posts of the cylinder, four openings are obtained for the admission of steam, each equaling in length the diameter of the cylinder. The exhaust is through a double opening, which also gives a quick opening and a sharp cut-off. The valve works without appreciable wear and will remain tight a long time. Wearing down does not produce a leak, and should the wear of the pressure plate loosen the valve it can easily be tightened and brought up to place by the adjustment of the distance pieces that support the pressure plate. These distance pieces are attached to the valve seat by brass machine screws and can easily be removed for purposes of adjustment.



THE WESTON AUTOMATIC ENGINE.

The governor is of the class which has a laterally movable eccentric surrounding the crank shafts of the engine, by which the admission of steam to cylinder is regulated through the variations of its throw. This variation is effected by the movements of centrifugally acting weights connected by levers to the eccentric, while the centrifugal motion of these weights is resisted by centripetally acting springs, the free ends of which are attached to weight levers, the other ends being attached in an adjustable manner to fly-wheel. When at rest the weights are in position to give the greatest throw, while in motion the action of the weights reduces the motion until it reaches the point where the valve travel will be in accordance with the amount of steam necessary to drive the load. A regulation within two per cent from friction to full load is secured by this governor.

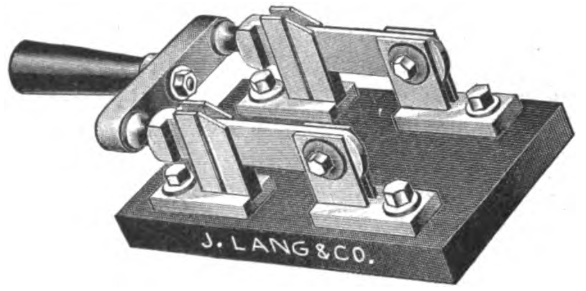


FIG. 1.—IMPROVED LANG SWITCHES AND CONNECTIONS.

The crank shaft is made of steel in one piece, giving a strong construction. The connecting rod is a steel forging. The cross head end is constructed so that the box may be removed without taking out the pin. Every moving part is provided with suitable lubricating devices of modern design. The engines are furnished either with or without sub-base as may be desired. Engines furnished without sub-base are provided with cast iron foundation plate which has a groove around the outside to catch any oil or condensing water that may drip from the engine.

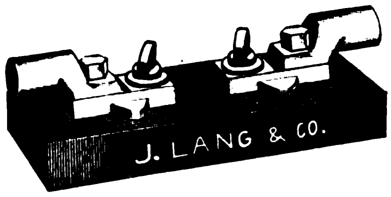


FIG. 2.—IMPROVED LANG SWITCHES AND CONNECTIONS.

Improved Lang Switches and Connections.

Among the recent improvements made by J. Lang & Co., of Chicago, is the method of constructing certain styles of switches. Instead of using cast brass for the different parts of the switch, the switch shown in Fig. 1 is made entirely of rolled copper. The blades, clips and base are of pure rolled copper, which, while being the most durable, is also a more perfect conductor. This style of switch is made in sizes from 50 amperes to 3,000 amperes for 110 volts, and when desired for as high as 2,000 volts. It is made in central station or throw over style.

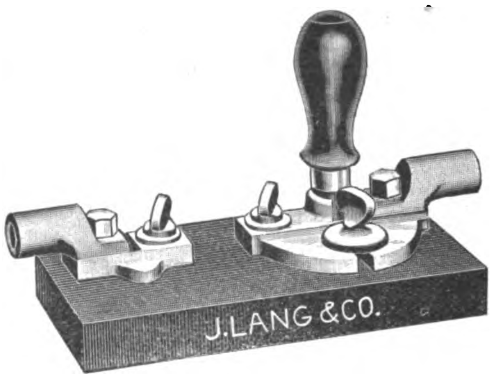


FIG. 3.—IMPROVED LANG SWITCHES AND CONNECTIONS.

Other improvements in construction are illustrated in Figs. 2 and 3. The connectors in both the plug switch and the fuse block are easily detached from the bases, and can thus be much more easily soldered to the cable. The different parts are carefully made to sizes and all surfaces perfectly smooth, so as to insure the least resistance possible. The work of this firm in the manufacture of switches and the construction of switchboards has gained for it an established reputation. Some of the finest switchboards in the west have been constructed by J. Lang & Co. The new ideas introduced have entirely changed the appearance of the board, adding much to its durability and efficiency.

Autograph Recorder for Electric Light and Power Stations.

An important item in the operation of every plant is the keeping of the record of the load carried, together with various other items that are essential in studying economical operation. Various schemes are employed for making and preserving this record, but in the accompanying cuts is illustrated an improved method, placed on the market by the New National Time Recorder Company, of Milwaukee, Wis. It is not only an excellent method of keeping a record of the various items, but also a check on the attendant, showing that he is in discharge of his duties.

In Fig. 1 is shown the device, which is about 17 inches square. A clock, used to drive the record dial, is attached to the face as shown. The case, which is of nicely finished wood with a plate glass face, is securely fastened by lock and key so that it is impossible for the attendant to interfere with its operation. A printed dial is inserted daily on which the record is made. This paper, as shown in Fig. 2, is ruled in circular columns, over each of which is printed the name of the quantities to be recorded. Each hour and half-hour is printed on the inner circle, the night hours being designated by the heavy black rule. A place for the dynamo tender's signature is also left so the record shows by whom it was made.

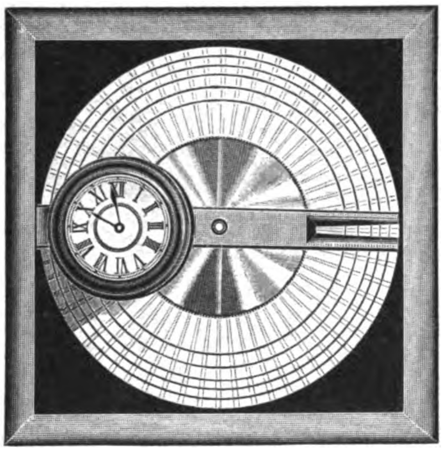


FIG. 1.—AUTOGRAPH RECORDER FOR ELECTRIC LIGHT AND POWER STATIONS.

The dial shown is intended to record the amperes, volts, steam pressure, vacuum, dynamos cut out and dynamos started. An opening one-half by three and one-half inches is left on the plate glass front for making this record, and as the dial is turned the record cannot be changed. The section, Fig. 2, shows a record made at 5 P. M., by J. Davis, the day man, and one at 6:30 by S. Snow, the night man. The dials are made for a period covering 30 hours so that if they should not be changed at the regular time the record would not be lost. The dials always synchronize with the clock so that the hour on the record corresponds with the time by the clock.

The clock has a marine movement and will consequently run whether the recorder is fastened to the wall or laid on the desk. The advantages of this device are at once apparent to the station superintendent. A neat, clear record is of great value, while a bungling record is of almost no value. The convenience of preserving these records, if not tabulated at the office of the company, is also one important feature. The recorder can be easily adapted to any other line of business by simply changing the cards for those which have the required data printed on them. The whole is compact and substantially made so that it will last as well as any of the apparatus of the station.

The Lawrence Conduit Electric Railway System.

Inventors working on the problems, which the operation of the electric railway presents, have many of them been working on systems in which the overhead trolley wire is entirely abolished and bare conductors carrying current as far as possible. The system invented by Mr. William Lawrence and placed before the trade by the Lawrence Electric Co. of 59 Wall St., New York, follows these ideas. The current is transmitted over the road through insulated buried conductors which are automatically connected with sections of trolley wire in the underground conduit and again disconnected as the car passes over the section.

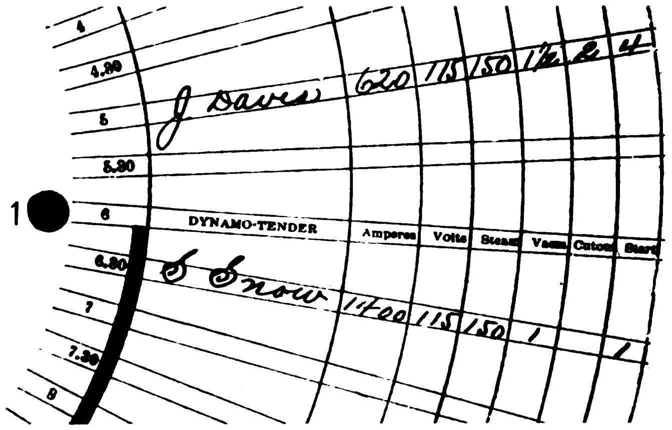


FIG. 2.—AUTOGRAPH RECORDER FOR ELECTRIC LIGHT AND POWER STATIONS.

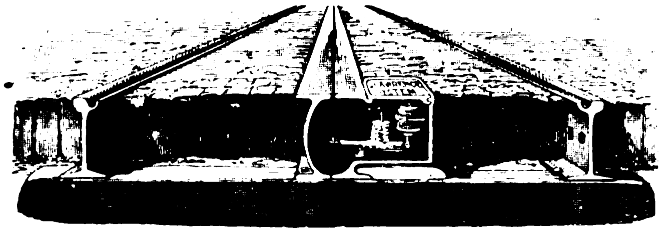
The conduit is small (4½x9 inches) and is supported on the ties that support the rails. It is inexpensive compared with the cable conduit and can be introduced on many horse roads without rebuilding the track. Through and along the conduit formed under the slot passes a small girder or trolley rail in 32 foot sections, fastened together by fiber pieces, so as to insulate the different lengths. Each rail is carried by levers which run out at right angles thereto. On the outer end of the levers are weights which overbalance the girder, no springs being employed. The other end of each lever is connected to a circuit breaker which connects by vertical connection with a feed wire in the junction box. When the weights raise the trolley rail, as they normally do, the circuit is open and the trolley rail receives no current.

When the car is above any given section it depresses the trolley rail a little, forcing up the other end of the lever and closing the circuit so as to bring the depressed section of the trolley rail into electrical contact with the feed wire. As the car passes from the section of rail, the rail is raised by the weights on the lever and the circuit is broken by gravity.

The car carries a special trolley device two feet six inches long, with a wheel at each end, which is a radical feature of the system inasmuch as it prevents sparking. Between the trolley and the car is an elliptical spring, so that the shoe is always forced downward. It is the pressure of this spring that directly depresses the section of trolley rail. Another object of the two rollers is to enable the car to force down the rail in advance, before it leaves the rail it is just passing over; this prevents jarring as the rail junctions are passed. From the trolley the current is taken by ordinary connections to the motor, passes through the same, and then returns to dynamo house through the rails, or can be returned by wire, the system being admirably adapted to the use of the latter. Whether a single or a double line of track be laid there is required only the one feed wire, and only the one set of circuit breakers with one or with two sets of levers. This feature is brought out very clearly in our illustration of the double track system.

Another important feature remains to be spoken of. It is assumed that the conduit will naturally accumulate dirt. To dispose of such, a brush pressing against the bottom of the conduit may be attached to the trolley shoe which will sweep all dirt before it. Every 1,000 feet or so a special pit and dirt chute, is provided down which the dirt accumulated in front of the brush falls, thus keeping the conduit clean.

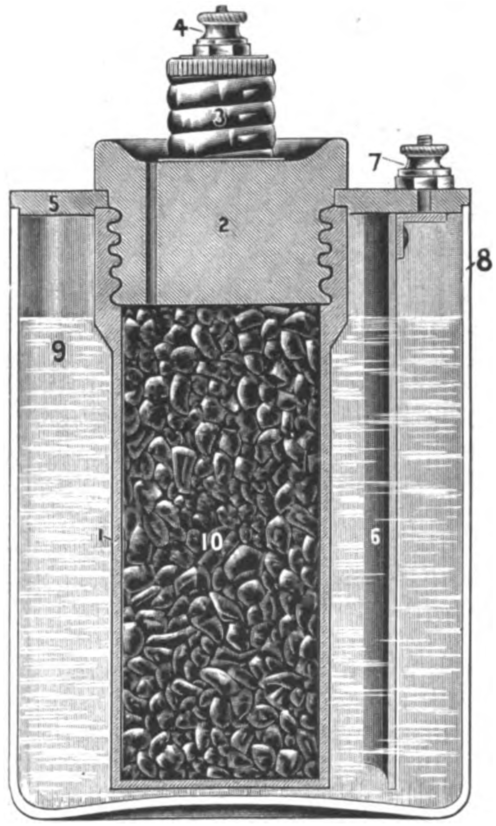
The original cheapness of installation is in its favor. When no car is on the line, the dynamos simply keep the perfectly insulated cable charged. There is absolutely no draught on them for current, as the leakage is virtually zero; if a single car is sent over the line, the system is only subject to the trifling leakage which may be incurred by the depression of a single section of the trolley rail all the time and of two sections for a very small fraction of the period. It is actually proposed, as a matter of cleanliness, to periodically flush out the conduits with water, a process which, in the case of the ordinary underground electric systems, would involve a certainty of disaster. It is not easy to see how any accident can happen to the system. If one of the circuit breakers or junction boxes, as they are called, gets out of order, the utmost harm it can do is either to keep a 32 foot section alive—involving, perhaps a trifling leakage—or to throw the section totally out of circuit, a matter also of the least possible importance, as the car, by its inertia, would readily pass the place. A junction box can be replaced in five minutes. If any accident should happen to one or more sections of the trolley rail, the system would be still in a condition to be used, and would not have to lie idle.



THE LAWRENCE CONDUIT ELECTRIC RAILWAY SYSTEM.

The Electric Light and Power Controller.

The advantages of being able to cut off a light or group of lights or a motor from a central point without disturbing the other lamps or motors on the circuit, are many. To the central station manager the saving in current is the main item, while it also enables him in the construction of his lines to place lamps used at different times in the day on the same circuit. This is the work performed by the controller manufactured by the Electric Selector and Signal Co., of 45 Broadway, New York. The apparatus consists of three parts, the transmitter, the selector and the switch. The transmitter is placed in the central station and consists of a disc or number of discs arranged on an axis, each disc having on its periphery elevations or contact points, which, while rotating, send out current in impulses, which impulses actuate the other devices. The selector is an instrument on the line having a disc, the elevations on which correspond with the notches on the disc in the transmitter. If the right number of impulses are received two contact points are closed making a circuit through the switch apparatus and opening or closing the switch according as the contacts are made. The other selectors on the circuit are not affected, as the combinations on the discs are not the same. The instruments and appliances used are small and require but little space; a space eight by eight by four inches on the desk at the central station is all required for the transmitter. A single wire from the station will operate the entire system.



THE HAYDEN CARBON POROUS CUP CELLS.

The Hayden Carbon Porous Cup Cells.

In the manufacture of primary batteries many improvements have been made, which, while maintaining their efficiency, have greatly increased their durability. The expense of producing electricity by this means has thus been reduced and the batteries are becoming in every way more reliable. The Hayden-Booker Mfg. Co. of St. Louis, Mo., has constantly improved the character of its batteries and adapted them to the different places in which they are used. A substantial construction of the jars, cups and connecting parts gives the batteries a long life with but trifling expense for renewals.

The Hayden carbon porous cup cell illustrated in the accompanying cut has a number of special features in its construction. The parts of the cell are made so that parties using standard sizes of jars may use them in connection with this battery. The porous cup is about one quarter of an inch thick, with a special screw top that receives, and which, as shown in the cut, holds the cover of the jar. This cover is tight, does not absorb moisture, and being close grained is easily kept clean. At the top, 3, is shown the metal screw top used on all the batteries. The experience gained in the manufacture of batteries and in the use of materials has enabled a combination to be used which does not corrode, as tests extending over two years show. The binding posts are carefully made and the resistance of the cell by this means kept at a low figure. The zinc is introduced as shown, and varies in size with the three sizes of cells in which they are made. The smaller size, No. 1, is intended for open circuit work and the parts will fit any Leclanche jar. It is adapted to bells, gas lighting, telephone and similar work. The next size has twice the recuperating power of the above and is adapted for heavier work, while the larger size is intended for places where it is not advisable to use a closed circuit cell for intermittent work. The cells have each a voltage of 1.55 and minimum amperage of respectively 3, 6 and 9 amperes.

In renewing these batteries they are filled with a solution of white salammoniac and the porous cup with manganese. There is no part of the battery to be thrown away, but after long service only the chemical elements are to be renewed. The company manufactures a full line of batteries of the several kinds, but these will serve to illustrate the character of the goods and the improvements which increase their usefulness.

Electric Track Welding.

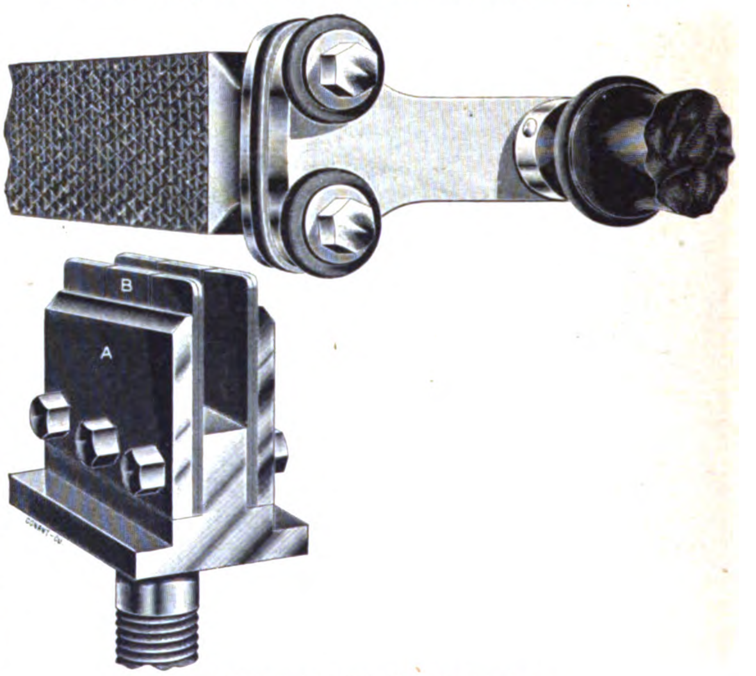
The subject of providing a suitable return circuit for electric street railways was taken hold of by the Johnson company about two years ago, and after a practical trial of the method during the intervening time the present results seem in every way satisfactory. The plan of the above company was to utilize the large amount of metal in the rails for this purpose by welding the sections into one continuous rail. In this manner loose joints, defective bonding and the auxiliary conductors are entirely avoided. On the line of the West End road, Boston, where several miles of track were welded, the rails broke in several instances near the welds, but this trouble, it is said, has been overcome.

The apparatus employed in welding the track consists of a car mounted on two four-wheel trucks. This car is equipped with two 50-W. P. motors, with the usual controlling devices of the ordinary electric car. At one end of the car is a transformer, which resembles very much the four-pole G. E. 100 K. W. generator. The current obtained is an alternating current, which passes through a regulating induction coil, then through the transformer in the welding machine proper. From the opposite end of the car from that in which the transformer is located a crane projects which supports the welding machine. This machine, which was manufactured by the Thomson Electric Welding Company, has been specially designed for this work. The crane allows the machine to be set over either rail, and a joint adjusted by a screw sets the jaws the right distance apart. The secondary coils of the transformer lead to copper plates on the face of the jaws, between which the welding is done. The current used is of low potential, about four volts.

In making a weld the web of the rail is first polished by emery wheels. The joint is then held rigidly by being clamped in a gun metal casting while the joint is being made. Lugs are placed so as to cover the joint, and after the contact plates are screwed down the circuit is completed. By tightening up the plates the molten metal is forced into the crack between the ends of the rails. Carbon placed on the top of the rail hardens the tread. It requires from two to three minutes to make the weld, and when completed the tread and flange are smoothed up with the hammer. The joint is often so smooth that is quite impossible to detect a joint. From 30 to 50 joints are made a day.

Under the direction of Mr. G. Milton Brown the work of welding the reconstructed track of the Baden & St. Louis Railway is being rapidly carried on. The road is about three and one-half miles long and double track. No difficulty will be experienced, it is said, from the expansion or contraction of the rails due to changes in temperature. The success of this method will be watched with interest by the many electric roads in the country to whom the satisfactory solution of the problem is of vital importance.

Improvement in Switch Construction.



IMPROVEMENT IN SWITCH CONSTRUCTION.

A decided improvement in switch construction, which is covered by letters patent recently issued, is being employed in the manufacture of switches by the W. S. Hill Electric Company. The thin strips of brass or copper between which the blades of the switch closes often become bent and warped, affording a poor connection and preventing a quick break. The old method also of securing the blades to the yoke, to which the handle is attached by a single bolt, often allows the blades to be twisted and one blade moved in advance of the other, causing excessive sparking whenever the switch is opened or closed.

To overcome the latter defect and produce a more perfect device mechanically and more efficient electrically, the outer ends of the blades and yoke have been broadened and two screws or bolts inserted, securing the parts rigidly and holding the blades so firmly that they move in unison and sparking is entirely avoided. To overcome the first defect above mentioned, reinforcing plates, A, as shown in the cuts, are introduced to back up the regular flexible contacts, B. The flexibility of the contacts is maintained and the contacts are always held in proper position and perfect contacts always assured. The carrying capacity of the plates, B, is also increased by the reinforcing plates. A maximum carrying capacity is thus secured that is sufficient to prevent any heating at the switch. There are now in use hundreds of these switches by which perfect satisfaction is said to be given. The full value of the switch is shown after long service when their durable qualities become more noticeable.

LEGAL NOTES.

DAMAGES FROM A CENTRAL STATION.

A suit for $30,000 damages has been entered by Douglas D. Waite and Abram C. Devitt in the Circuit Court against the Chicago Edison Company. It is claimed by the plaintiff's that the operation of the Adams street station of the defendant company has seriously reduced the patronage of their hotel and restaurant, and that their income has been greatly reduced on that account.

DECISION ON FIELD ELECTRIC RAILWAY PATENT.

Judge William K. Townsend, of the United States Circuit Court at New Haven, Conn., rendered a decision on May 3d in the suit for infringement of the letters patent granted to Stephen D. Field on July 16th, 1889, on electric railway improvements. The defense was a denial of infringement, that prior patents covered the improvements. The judge held that the English patent issued to one Clark in 1864, covered nearly every point in the pateut of Field, and gave his decision against the plaintiffs. The General Electric Company appeared in the defense having taken up the suit from the Sprague company.

SUIT FOR INFRINGEMENT OF DISTRIBUTION PATENTS.

The Edison Electric Light Company has instituted suit against the Westinghouse Electric & Mfg. Co., and the New York Insulated Wire Co., to recover royalties for alleged infringement of patent issued to Thomas A. Edison in 1882, for improvements in the electrical distribution system of incandescent lighting from central stations. The Westinghouse company has filed an answer in which it denies entirely the right of the Edison company to the patent. It was old and well known prior to any invention or discovery thereof by Edison and involved merely the exercise of ordinary engineering skill and judgment; and it is also alleged that the transfer of the patent by Edison to the Edison company was not registered in the patent office until 1888.

MAGNETIC SEPARATOR PATENTS.

At the April term of the United States Circuit Court held in New York, Judge Coxe entered an interlocutory decree on Magnetic Separator Company against William D. Hoffman. It was declared that the defendant infringed patents, the property of the Magnetic Separator Company, and granted to Clinton M. Ball and others, by making, using and selling systems or plants for the concentration of iron ores, as exhibited and operated at the Clover Hill mines and Croton magnetic mines, Westchester County, New York; at the mines of Wetherbee, Sherman & Co., near Port Henry, N. Y., and at the mines of the Chateaugav Ore and Iron Company, Clinton County, New York. The Court decreed the payment of profits derived from such infringement by the defendant, any damage sustained thereby and the costs of the suit, and also enjoined the defendant from further infringement.

INJUNCTION AGAIN DENIED AGAINST BUCKEYE ELECTRIC CO.

On May 4th Judge Ricks, of the United States Circuit Court, Northern District of Ohio, denied the application of the General Electric Company for an injunction to restrain the Buckeye Electric Company of Cleveland, Ohio, from the manufacture of incandescent lamps. The motion was made on the grounds that additional information was now in possession of the company not possessed at the time the previous injunction was dissolved. The counsel for the General company presented in affidavits that at the time the owner of the patent and the assignee thereof made their application to the patent office in October, 1883, asking for a limitation of the life of the patents, and at the time of the proceedings taken under said application, a contract was in force by which the owner of the patent had given the exclusive right to manufacture lamps under the patent to Edison, the patentee and to certain persons whom the contract stipulated might be associated with him in that undertaking. The contract was made on the 8th day of March, 1881. On the 12th day of January, 1884, Edison and his associates named in the contract of March, 1881, assigned and transferred to the Edison Lamp Company, all their title and interest in said contract and also all their interest in a second contract between the Edison Electric Light Company and the Edison Lamp Company, made October 11, 1883. The right to exclusively manufacture lamps, thus vested in Edison and his associates was in force when the owner of the patent and Edison joined in the patent office application of October, 1883. The associates of Edison in that exclusive right, it is claimed, were not advised of what Edison and the owner of the patent did with reference to the said proceeding in the patent office, were not bound thereby and that, so far as their rights in that contract are concerned, they are not now estopped from claiming a preliminary injunction by any acts of the owner of the patent or the patentee. The judge holds that between October, 1883, and March, 1893, the endorsement in question appeared on every copy of the patent and that although those associated with Edison may not have authorized the act they must have obtained knowledge of it soon after the act. While Edison estopped himself from claiming an injunction by his acts and conduct between October, 1883, and March, 1893, as found in the decision hereinbefore referred to, it does not follow that his associates were likewise estopped. But in this hearing it ought affirmatively to appear that those parties who claim a prior equity to the defendant,were ignorant of, and did not participate in or authorize, the several acts and the line of conduct which, it has been held, estopped the other plaintiff from claim relief against these defendants. This should appear so satisfactory as to justify the court in granting this unusual relief. The burden of proof is not on the defendants but on the plaintiffs, and the Court concludes that the latter have not established their claim to a prior and superior equity not affected by the estoppal heretofore found.

The photographs, from which the illustrations of the lighting of the mid-winter fair in the May number of ELECTRICAL INDUSTRIES were taken, are by Taber of San Francisco who has spent a great deal of time and money in endeavoring to preserve my means of photography some of the wonderful lighting effects of the fair. The field which he has entered is new in the art and a series of experiments were necessary in order to determine the plates to be used and the best method of using them. Three weeks were spent in getting the photograph of the tower which appeared on the front page. This photograph is the result of different exposures at different periods from six to nine o'clock in the evening.

A BRIEF REVIEW.

THE DEPTFORD STATION.

It is believed by the engineers and directors of the London Electric Supply Corporation that the undertaking, which has been in a deplorable condition since its commencement, is now emerging from darkness into light. That may be the case, but, judging from the expressions of opinion at the annual meeting of the company last week, the shareholders as a body have practically given up all hope of receiving any return for the £800,000 expended in the enterprise, which from the Deptford generating station was to supply the metropolis with millions of incandescent electric lamps. That idea, which originated with Mr. Ferranti, ably supported by the directors, has never been realized, and only some 62,000 lights are now being energized as compared with 46,197 in 1892. A little time ago the undertaking was in such a lamentable position that it was mortgaged to one of the directors for £80,000, or only one-tenth of the money expended upon it; and unless further capital to the extent of £30,000 is forthcoming for carrying on business during the next two years, the result may be imagined. During the past year a number of uneconomical transformers have been replaced by others of an improved type, and the result is shown by some figures prepared by the engineer to the company. For instance, during the quarter ending December last only 45.43 per cent of the current transmitted from Deptford was utilized in the lamps supplied in the metropolis, the remainder being made up by 3.37 per cent loss in transmission, 3.50 per cent used in the station converters, and 47.70 per cent in the house transformers. During the quarter ending March the improvement is shown by the fact that the current used in the lamps reached 53.80 per cent, and at the moment it has reached 62 per cent. It is expected that an efficiency of 70 per cent will soon be attained. But the disasters which have dogged the undertaking since its start, and the lowering of prices owing to rate cutting by other companies, have been two of the main drawbacks to the enterprise, the former having had the effect of causing consumers to receive their supply from other companies, and the latter having reduced the income. It would be a pity for the undertaking to come to grief, but, as the chairman remarked, the result of embarking on the unknown is illustrated in this case.--Mechanical World.

THE DECLINE IN PRICE OF ELECTRICAL EQUIPMENTS.

In commenting on the business situation and the decline in prices of electrical apparatus, the Electrical Review says: "Six years ago the price for a complete equipment for a trolley car, including two motors, was about $4,500. This price held for a year and a half and then dropped to $3,850, $3,500 and $3,300, until two years ago it was about $2,850. One year ago $2,000 was the price of the same equipment, greatly improved in quality and efficiency, while today the average price is between $1,000 and $1,200. We have been told of an electric railway manager who desired quite recently to purchase an equipment for a single car. He wrote to seven manufacturing companies, and immediately was called upon by seven salesmen, all of whom had paid traveling expenses to try for the order. The prices quoted ranged from $1,500 to $640. The manager bought the $640 apparatus. Here we have a decrease in actual selling prices from $4,500, in 1888, to $640, in 1894, a period of six years. In 1888 there were seven electric railways in the United States. In January, 1890, there were 162 electric railways in operation and in process of construction. In January, 1891, this number had grown to 281, while today there are probably over 500 cities in the United States equipped with electric roads, many of them of great mileage, as in Boston, Brooklyn, St. Paul, Minneapolis and Cincinnati.

"This marked reduction in the price of railway apparatus during the short period of six years is due largely to competition between manufacturing companies, but chiefly to a reduction in the cost of manufacture, accompanied by an increase in the quality of the product. The margin of profit on the equipment mentioned at $4,500, in 1888, was not as large as it was on a better equipment at $2,850, in 1892, owing to the reduction in the cost of manufacture. While prices have been fearfully cut during the last year by all the manufacturing companies, partly due to intense competition and partly to the business depression, we do not believe that any company can make and sell a satisfactory car equipment for $640 and clear a profit on it."

THE USE OF EXHAUST STEAM.

The use of exhaust steam is the more profitable as the percentage of the steam utilized is increased and as the back pressure produced by its use is reduced. If we add back pressure to an engine we increase the mean pressure required upon the piston in order to maintain a given mean effective pressure; that is, we increase the horse power of the engine, so far as the boiler is concerned, by an amount equal to the horse power constant multiplied by the back pressure added, and require a proportionately greater supply of steam. The condensing engine may be considered in the same way. Suppose we have an engine which develops one-horse power for each pound of mean effective pressure, running on a mean effective of 50 pounds, an absolute back pressure of five pounds, and a steam consumption of 20 pounds per hourly horse power. If we cut off the condenser and exhaust at atmospheric pressure, we shall have added 10-horse power to the work of the engine, requiring 200 pounds of steam additional per hour. As this additional horse power is used in overcoming the increased back pressure, the effective horse power remains at 50, and the steam consumed per effective or indicated horse power per hour is increased 25 per cent. Now, if we have an application for as much or more heat as would be furnished by 200 pounds of boiler steam, we can take it profitably from the exhaust. If not, it would be better to use steam direct from the boiler.—Power.

HOW FAR CAN ELECTRIC POWER BE COMMERCIALLY TRANSMITTED?

An estimate of the distance to which Niagara water power can be economically transmitted by electricity is given by Messrs. E. J. Houston and A. E. Kennelly in the Electrical Engineer of May 2. The article says: "It is recognized that the limiting commercial distance depends upon two associated interdependent factors: viz., cost and electric pressure. Cost, including the purchase and maintenance of the necessary machinery and wire, together with the annual interest chargeable upon such expenditure. Electric pressure, the pressure or voltage at which the line transmitting the power can be operated with continued security to life and assurance of permanence of supply and permanent protection to the lines of conductor from lightning, weather and all disturbances." Up to the present time the commercial distance at which water power has been distributed is only about 25 miles and the distance to which it might be distributed commercially under ordinary conditions has been generally regarded as a radius of 50 miles. In one sense the celebrated exhibition in 1891 of the transmission of about 200 horse-power from Lauffen to Frankfort, acted as an incentive to long distance electrical transmission, since it revealed the capability and feasibility of the system, but at the same time this notable experiment has, perhaps, also retarded the progress of the art it was designed to foster; for the cost of installing the entire plant of turbines, generators, aerial conductors and transformers, is said to have been $84,600." As the plant did not deliver over 200 horse-power the cost per horse-power would be $423 or $567 per kilowatt. The annual cost of producing this power in Frankfort could be hardly be less than $100 per kilowatt, commercially a prohibitory rate. The distance was 109 miles; the voltage between triphase conductors 13,000 to 30,000 and the frequency 40. "Seeing that the Lauffen-Frankfort electrical transmission experiment would be a failure commercially, it becomes important to ascertain how far in the near future, power can be electrically transmitted from Niagara Falls at commercial rates." Three methods are mentioned for the disposition of the conductors, the conduit method in which insulated conductors are buried in underground pipes filled with air or oil, the subway method in which wires are suspended from brackets in an underground passage, one of these methods being considered necessary in cities to ensure safety, and the aerial method which is considered sufficient in every way along the canal bank and which is by far the cheapest method. "We shall now assume that the engineering difficulties can all be overcome by bare, overhead, triphase wires, at 35,350 volts receiving pressure, with step up and step down transformers at the ends of the line. It remains now to consider only the question of cost. We require to estimate the annual cost of producing one kilowatt steadily at the turbine shafts at Niagara Falls. It has been stated that the estimated cost of the hydraulic works, for a total of 119,000 horse-power at Niagara is $17.60 per horse-power or $23.587 per kilowatt." The cost of power per annum at turbine shafts is estimated at $4 per kilowatt or $2.984 per horse-power. The cost of generators in these large sizes, say 4,000 K. W., is placed at $8.516 per kilowatt or $6.352 per horse-power including exciters and station apparatus. Motors, being required in smaller sizes, are placed at $9.581 per kilowatt or $7.146 per horse-power. Transformers at $5.157 per kilowatt ($3.847 per horse-power). Superintendence and operating expenses are placed at a total of $200,000, two dollars per horse-power, $2.681 per kilowatt. This estimate is based on a distribution along the Erie canal of 67,500 kilowatts or 90,500 horse-power. Albany is the first city considered, at a distance of 330 miles from the power house and which is to receive a maximum delivery of 15,000 kilowatts. The estimate for the installation is $112,690, based on cost per kilowatt as follows: Cost of generator, 1.926 K. W. to deliver one K. W. at Albany, $26.750; copper in lines, 391.9 pounds, $48.987; one kilowatt motor at Albany, 14.953 and cost of 330 miles of line at $1,000 for 15,000 kilowatt $22. Interest, depreciation and repairs 10 per cent, $11,269, cost of 2.048 kilowatts at turbine shafts, $8.192, labor and superintendence $2.681 or a total cost per kilowatt of $22.14, with a delivery of 15,000 kilowatts. At average of 60 per cent of full load the cost per annum per kilowatt is placed at $27.53 per horse power or $36.90 per kilowatt. At Syracuse at 164 miles a maximum delivery of 7,500 kilowatts, the annual cost per horse-power at sustained full load, $12.85 per horse-power or $17.223 per kilowatt at 60 per cent of full load $21.414 per horse-power, or $28.705 per kilowatt. Buffalo, 15 miles, maximum delivery 22,500 kilowatts the annual cost per horse-power at sustained full load $7.978 per horse-power or $10.694 per kilowatt. At 60 per cent of full load $13.296 per horse-power or $17,823 per kilowatt. In conclusion the writers state that "the foregoing results indicate that on a basis of prices and voltages assumed and detailed the power of Niagara Falls can be transmitted to a radius of 200 miles, cheaper than it can be produced at any point within that range by steam engines of the most economical type with coal at three dollars per ton. The Niagara power can maintain at Albany a large day and night output cheaper than steam engines at Albany can develop it, but that for power taken at Albany for 10 hours per diem the best steam engines have somewhat the advantage over Niagara unless exceptionally favorable conditions of load could be secured for Niagara power."

"The broad conclusion to which an inquiry of this nature inevitably leads, is that while under ordinary conditions the commercial limit of electrical transmission of power from water powers of less than 500 K. W. can hardly exceed 50 miles. The radius at which it will be profitable with good fortune and management to electrically transmit a water power aggregating 50,000 K. W. or more, is, perhaps, today 200 miles and that it might be commercially advantageous for such a large water power to undersell large steam powers at twice the distance with no profit in order to reduce the general expense upon delivery nearer home. The reason for this difference in the transmission radius between small and large water powers, lies obviously in the fact that electrical and hydraulic machines can be built and purchased much more economically in large sizes than small, so that the cost of producing and of maintaining one kilowatt is very much less for large than for small water powers."

A HISTORY OF THE STORAGE BATTERY.

A brief history of the storage battery is given by Mr. Thomas Walcott in an article on "The Storage Battery and its Uses" in the Engineering Magazine, as follows:

Important as it now is, the storage battery may be traced to a very obscure origin. In 1801 Gautherot, a French scientist, while using a voltaic battery with silver-wire electrodes to decompose saline water, noticed that, upon disconnecting the battery, the vessel containing the saline solution and the silver electrodes was capable of furnishing a current of short duration in the direction opposite to the original current. In 1803 Ritter observed a similar action with gold wire, and constructed a battery out of pieces of gold separated by discs of cloth moistened with a saline solution. This resembled the pile of Volta, except that the plates were of one metal.

It is worthy of note that this first storage battery should have been made so early in the history of the voltaic cell, for there was a well-directed attempt to practically utilize the reverse current phenomenon, which received the name of polarization. Years after this polarization was a great source of annoyance in primary batteries. After a primary battery had been in operation for a time a marked falling-off in the electro-motive force (or intensity, as it was then called) was observed. This was found to be due to the collection of hydrogen gas on the unattacked electrode, and in 1836 Daniell invented the well-known sulphate-of-copper battery, which evolves no hydrogen but deposits copper on the copper electrode. As there is no change in the surface of the electrode there is no polarization, and this was the first depolarized battery. Polarization was also an evil to be overcome in the solutions used for the electro deposition of metals.

From the times of Gautherot and Ritter to 1860 there were some discoveries in the direction of the modern storage battery, but in the last-mentioned year Gaston Planté brought out a cell which was the beginning of the practical storage battery. This cell consisted of two sheets of lead, separated by a cloth and rolled into a cylindrical form. The roll was placed on end in a jar of dilute sulphuric acid, and charged, first in one direction and then in the other, with intermediate discharges. After this treatment had been repeated a great many times the chemical action penetrated deeply into the plates and increased the storage capacity in a corresponding degree.

This "forming" process, as it was called, was tedious and expensive, and to obviate the necessity for it Camille A. Faure, in 1881, used a layer of lead oxids spread over the surface of the plates. This layer of oxid was converted by the action of the current in one plate into peroxide of lead, and on the other into metallic lead in a spongy or porous condition. The active material, as these layers were called, from the fact that they constituted the portion of the cell which furnished the current, had to be held in place by felt diaphragms or partitions. It will be observed that this construction differs from that of Planté only in starting with ready-formed oxide of lead.

One of these cells was sent from Paris to Glasgow and was examined by Sir William Thomson, who considered it a wonderful advance in battery-construction and stated that it contained 1,000,000 foot-pounds of energy.

This certainly was a large amount of energy for one cell of storage battery to contain, especially at that time, but as compared with the energy stored in coal it is small—not greater than the amount of energy utilized from one pound of coal by a good steam-engine. The interest in the storage battery excited by Sir William Thomson's favorable report gave it an impetus so great that its practical use may be said to date from that time.

The next improvement was to use a perforated plate (or "grid"), which appears to have been invented by G. Philippart, though it was patented in France by E. Volkmar. Philippart filled the perforations in his plate with finely-divided metallic lead, but the results were not so satisfactory as those afterward obtained by using Faure's oxid paste to fill the grids. Sellon used an alloy of lead and antimony for the grids, instead of pure lead. These combined inventions have since been known as the Faure-Sellon-Volkmar system.

There are now in use two types of storage battery which far out-numbers all others. One consists of grids filled with Faure's paste, and the other of modified Planté plates. The merit of the grid is that it holds the oxid so that felt or other diaphragms are unnecessary. In the improved Planté cells the diaphragms are likewise dispensed with. The storage battery thus improved is much simpler than any good primary battery. There is a series of flat plates alternately positive and negative, the number of negatives being one greater than the number of positives, so that the series begins and ends with a negative. These plates are insoluble in the acid, and not visibly altered by charging and discharging the cell. The liquid is dilute sulphuric acid alone, while most primary batteries that are at all powerful have two liquids separated by a porous jar.

There is another type of storage battery of commercial importance, known as the alkaline accumulator. The names connected with its introduction in France are Lalande, Chaperon, Commelin, Desmasures, and Bailbache, and in this country Waddell and Entz. The battery consists of zinc and copper electrodes, in caustic alkali. The zinc is dissolved and redeposited, and the copper oxidized and deoxidized. The chief merit of this battery is in its light weight in proportion to its output. The current output per pound weight is very large, but the electromotive force is only $\frac{7}{10}$ or $\frac{8}{10}$ of a volt, so that the power output is much less in proportion, as compared with lead batteries.

CORRESPONDENCE.

LETTERS FROM PRACTICAL MEN.

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay and in this way the value of this column to every one will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.— Ed.]

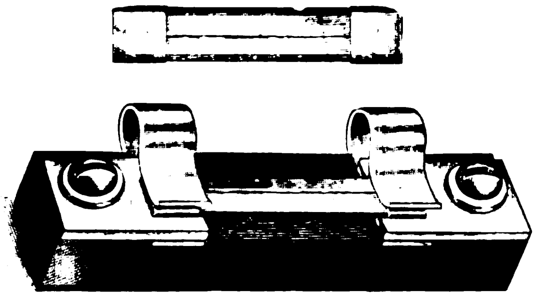
Editor Electrical Industries: I would like to study electrical engineering, and would like to get your idea as to what way to proceed. Do you think it best to take a college course or to learn in an electrical works? What college do you think best? Please give me your ideas on these points through the "correspondence column" of your journal. Yours very truly, J. H. M., Jr.

Poplarville, Miss., May 15.

In answering your questions we will suppose, as you do not give any information in your letter, that you are a young man with a common school education, and possessed of sufficient means to enable you to secure the required education in whatever way may be considered best. We will also suppose that you desire to become an electrical engineer and to follow that as a profession, after having considered your ability, natural tendencies and what success the profession promises. The foundation upon which the training of an electrical engineer is based should consist of a thorough training in mathematics, physics, chemistry and the modern languages. He must be a mechanical engineer as well and drawing, designing, hydraulic and steam engineering, should form part of his instruction. Electrical apparatus should be studied theoretically, as well as regards their practical construction and operation. For securing this education no better place can be found than one of our modern colleges where a three or four years' residence under the direction of the faculty will accomplish the desired result, if the student possesses the perseverance. A practical knowledge gained during vacations in the foundry, machine shop and the factory will be found of great value. When this has been accomplished, a year or two in the employ of a first-class engineer or in the engineering department of a manufacturing company should complete the training. Our large universities and technical schools furnish admirable courses of instruction with excellent equipments, but it would be difficult to decide which is best. Choice of residence, means at one's command, the future residence of the student, etc., would influence one's decision. If it is not possible to enter college a practical training in the works of one of the larger companies manufacturing electrical apparatus supplemented by a systematic course of study, will lead to a satisfactory knowledge of the subject. The National School of Electricity, recently established, offers a course of study which may be easily followed while persuing one's regular vocation. It is not intended to give the training of a college or technical school, but as a substitute for those who are unable to obtain the former.

New Fuse Links and Blocks.

The accompanying cuts show a new fuse link and fuse block from the laboratory of the Independent Electric Co. of Chicago. The wire used is produced by a new process from a special alloy, and although the cost of making is increased by reason of the jewel dies and cost of making, it is found to accomplish the desired end. It has heretofore seemed impossible to produce a wire from fuse metal by ordinary means, which would fuse accurately at as low a current as one half an ampere. Copper wire drawn to .002 of an inch is found to carry more than one ampere of current without melting. The various efforts made in the attempt to produce reliable and accurate fuse wire have been attended by many disappointments. This company has been very successful and is now making fuse links of the style shown in commercial quantities, which fuse at one-half, three-quarters and one and one-half amperes of current.


NEW FUSE LINKS AND BLOCKS.

The fuse link and holder shown is intended especially for telegraph, telephone and instrument work. The larger sizes are adapted for any fuse blocks, being fitted with different style of terminals. The terminals are very carefully soldered to the fuse links so that those points shall be of equal strength. The terminals for the heavy fuses are of a special design having a recess in the ends into which the fuse metal is soldered, giving greater strength and more perfect contacts. The stamped fuse links, although used largely, are as accurate as any made, but where a very close check is desired the better forms of links are considered preferable.

Wire Gauze Brush.

Many improvements have been attempted in endeavoring to make the connection between the commutator and the external circuits of the dynamo more perfect. Of these attempts the most successful have been in the better styles of brushes devised. A great variety of carbon and woven wire brushes have been placed on the market; of these the "gauze" brush manufactured by Lawrence Poland of 130 W. Second street, Cincinnati, O., possesses a number of special points of merit. The core of the brush is composed of a large number of pure copper wires, laid side by side and compressed into rectangular form. Innumerable contacts are thus presented to the commutator, of a slightly yielding nature which, while yielding to any irregularities of the commutator, give a perfect contact. The center mass of wires is slipped within a hollow form of wire gauze, previously prepared. The wires and gauze are then sewed together and one end dipped in solder. The bearing end of the brush is then dressed off to the desired shape. There are no ragged ends, no frayed or unravelled wires, but a uniform and yielding surface is presented to the commutator. They are both economical in use and easy to keep in order. For the various kinds of apparatus on which these brushes have been used they have proved satisfactory.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

LANSFORD, PA.—The Panther Valley Electric Light, Heat & Power Company contemplates the addition of a 1,000 light incandescent and a 60 light arc dynamo. John E. Lauer is purchasing agent.

MAUCH CHUNK, PA.—The Mauch Chunk Heat, Power & Electric Light Company contemplates the adoption of water power. O. O. Jarrad is purchasing agent.

SUNBURY, PA.—The Edison Electric Illuminating Company contemplates the addition of a new boiler, also the building of a two story brick office. C. J. Callahan is purchasing agent.

PITTSBURG, PA.—The Allegheny County Light Company will erect a new building; also the placing of its wires underground.

HOLLIDAYSBURG, PA.—The Hollidaysburg Electric Light & Power Company expects to light the town within three months.

WATSONVILLE, CAL.—The Watsonville Electric Light Company contemplates the addition of a wheel and an engine. Francis Smith & Co., 130 Beale St., San Francisco, Cal., are purchasing agents.

EMANS, PA.—The town plant may be improved and enlarged soon. B. B. Riefsnyder is the purchasing agent.

KENT, O.—The Kent Water & Light Company will add eight new arc lamps. A. B. Young is purchasing agent.

OXFORD, O.—The lines of the Municipal plant will be extended during this summer. Messrs. Tucker & Snyder are purchasing agents.

PORTSMOUTH, O.—The portsmouth Street Railroad & Light Company contemplates the addition of a 2,000-light alternating dynamo.

ST. CLAIRSVILLE, O.—The St. Clairsville Municipal Plant may have its capacity increased by the addition of an incandescent dynamo. C. S. Frint is the purchasing agent.

URBANA, O.—The Urbana Light & Power Company propose to do residence wiring and may arrange to burn crude oil instead of coal. Frank Talley is purchasing agent.

ALLEGHENY, PA.—D. Hunter, Jr., manager of the Municipal plant, will soon advertise for boilers, engines and dynamos for 450 arc lights; for 250 lamps to be erected; also for yearly supplies.

SEATTLE, WASH.—The Domestic Heat, Light & Power Company contemplates the purchase of a second-hand incandescent dynamo, and a 50 to 75-horse power engine. It is also in the market for supplies.

KITTANNING, PA.—The Kittanning Electric Light, Heat & Power Company expects to change its entire plant soon.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company is contemplating the installation of storage batteries. L. C. Lincoln is purchasing agent.

RENOVO, PA.—The Renovo Edison Light & Power Company may add an engine, boiler and two dynamos. J. H. Sheddy is purchasing agent.

ALTOONA, PA.—The Edison Electric Illuminating Company contemplate the erection of a fire-proof plant. E. B. Greene is purchasing agent.

GUTHRIE, O. T.—The Guthrie Electric Light & Power Company will increase its power capacity in all machinery this fall. W. H. Hilton is owner.

HAWARDEN, IOWA.—The City of Hawarden has awarded the contract for an incandescent lighting plant to J. H. Winchel, of Le Mars, Ia., on May 26. The plans and specifications were prepared by Wm. H. Bryan, of St. Louis. The contract includes a 36 kilowatt alternator, a 12x30 Corliss engine, two 80-horse power steel boilers, construction for 1,000 16-candle power lamps and 50 32-candle power lamps for street lighting.

NEW INCORPORATIONS.

Little Rock, Ark.—The Brown Electric & Manufacturing Co., capitalized at $31,000, to manufacture and handle electrical apparatus.

San Francisco, Cal.—The California Ground Electrical Company to operate electrical inventions, etc., $100,000.

Denver, Colo.—The Enterprise Plating Company with capital stock of $5,000, electro plating.

Chicago, Ill.—Mason Electric Co., capital stock $10,000, electric railway apparatus.

Chicago, Ill.—Cutler, Hammer Manufacturing Company, manufacture electrical apparatus on May 3, $4,000.

Chicago, Ill.—The Taylor, Belding Electric Company manufacturing electrical supplies on May 3, $10,000.

Portland, Me.—Portland Electric Works, capitalized at $50,000.

Holyoke, Mass.—The Peoples Electric Street Railway Company to build and operate street railways, capitalized at $100,000.

New York, N. Y.—Imperial Electric Lamp Co., to manufacture electric lamps and appliances, $250,000.

Bangor, Pa.—The State Belt Electric Railway Company, $200,000.

Monongahela, Pa.—Monongahela Magneto Telephone Co., on May 2, capitalized at $3,000.

Milwaukee, Wis.—The National Telephone Construction Co., $150,000.

San Francisco, Cal.—Pacific Stethophone Company with authorized capital of $600,000 to deal in stethophonic and telephonic apparatus and appliances.

Reading, Mass.—Reading Gas & Electric Company to manufacture and deal in gas, electric light, heat and power, $50,000.

Stoneham, Mass.—Stoneham Gas & Electric Company to manufacture and deal in gas and electricity for light, heat and power.

Hoboken, N. J.—The Chesley Electric Company to manufacture electric machinery and appliance, $100,000.

Camden, N. J.—Block Heat & Light Company to operate commercial electric plants, $100,000.

Highlands, N. J.—The West Shore Telephone Company to operate telephone system with capital stock of $3,500.

Lorain, O.—The Black River Telephone Company with capital stock of $10,000.

Philadelphia, Pa.—The Central Electric Railway Co., of Philadelphia and Delaware county, $60,000.

New York City.—Esmond Electric Traction Company on May 1, with authorized capital of $1,000,000.

Milwaukee, Wis.—Milwaukee Electric Launch Co., $10,000 to furnish transportation on Milwaukee river.

Indianapolis, Ind.—Indiana Telephone & Construction Company on May 11, $300,000.

Baltimore, Md.—White-Crosley Company for the manufacture of electrical dynamos, etc., $250,000 on May 11.

New Britain, Conn.—The Hardware City Telephone & Electrical Company to manufacture telephones and other electrical apparatus on May 7.

Roodhouse, Ill.—The Green County Electric Company on May 11, with authorized capital of $30,000.

Chicago, Ill.—The Gilliland Telephone Co. for the manufacture of telephone apparatus and other electrical machinery, on May 17, capitalized at $1,000,000.

Camden, N. J.—The Consolidated Electric Improvement Co. for the manufacture of Electrical appliances, on May 16, $100,000.

Cleveland, Ohio.—The Fletcher & Fletcher Electric Co., for the manufacture of electrical instrument, $10,000, on May 11.

Toledo, Ohio.—The American Electric Company to manufacture electrical apparatus, $10,000.

Portland, Ore.—National Telephone Company, on May 10, $100,000.

Philadelphia, Pa.—The Citizens North End Street Railway Company, on May 10, $36,000. The Citizens East End Ry., to operate street railways, $15,000 and the Northern Electric Street Railway Company, $150,000.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

South Braintree, Mass.—The Braintree Street Railway Company, which has constructed two miles of its line, is now awaiting action of legislature before going farther with the work. F. A. Hobart is president.

Atchison, Kan.—The Atchison Railway & Electric Light Company is now building a line of railway, 8½ miles in length.

Canton, S. D.—The Canton General Electric Company contemplates the addition of an incandescent system. O. S. Gifford is purchasing agent.

Beloit, Wis.—The Wiley-Warren Electric Company will add an arc light dynamo; also will erect circuit. C. W. Wiley is manager.

Santa Cruz, Cal.—The Municipal Electric Light Plant is to have its capacity increased by the addition of a 145-light arc dynamo for street lighting. W. W. Waters is superintendent.

Hallettsville, Tex.—The City Electric Light & Waterworks is not yet ready to buy, but would receive propositions for a dynamo, on a basis of taking old one at a fair valuation.

Wytheville, Va.—The Municipal Lighting Plant is to have its capacity doubled very soon. J. A. Mebane is manager.

AMONG THE CENTRAL STATIONS.

Mt. Sterling, Ill.—By changes of officials of the Mt. Sterling Electric Light & Power Company, F. W. Rottger is president and F. W. Crane secretary and purchasing agent.

Mt. Vernon, Ill.—At a recent election of the Mt. Vernon Electric Light Company, Geo. W. Evans was elected president and A. C. Tanner secretary, treasurer and purchasing agent.

Normal, Ill.—David Lelmley is secretary and purchasing agent of the Normal Electric Light & Power Company.

Paris, Ill.—C. W. Powell is president and F. A. Handley purchasing agent of the Gas, Light & Coke Company.

Afton, Ia.—J. F. Emory is manager and purchasing agent.

Atlantic, Ia.—A. M. Nipper has recently become purchasing agent and manager.

Avoca, Ia.—G. Diederich is president and E. Cook purchasing agent of the Electric Light & Power Company.

Centerville, Ia.—T. P. Shontz is president and W. M. Peatman secretary and purchasing agent of the Centerville Light, Heat & Power Company.

Indianola, Ia.—H. J. Watson is manager and M. A. Doshiell purchasing agent of the Electric Light Company.

Leon, Ia.—F. E. Thompson is manager and purchasing agent of the Leon Light Company.

Mason City, Ia.—F. G. Blythe is secretary and treasurer of the Mason City Electric Company.

Newton, Ia.—H. W. Vaughn is manager of the Thomson-Houston Electric Company.

Ottumwa, Ia.—Thos. H. Eaton is secretary and treasurer of the Ottumwa Electric Railway Company.

Shenandoah, Ia.—R. W. Morse is secretary and manager of the Electric Light & Power Company.

Winterset, Ia.—L. O. Klein is manager of the Winterset Electric Light & Power Company.

El Dorado, Kan.—O. R. Cline is owner of the Electric Light Plant.

Hiawatha, Kan.—E. Hoye is vice-president and purchasing agent of the Electric Light Company.

Leavenworth, Kan.—Wm. Tracy is manager and purchasing agent of the Leavenwoth Light & Heating Company.

Huntington, Ind.—A. Wilkerson is purchasing agent of the City Electric Light Plant.

Martinsville, Ind.—J. R Starkey is president of the Martinsville Electric Company.

Knightstown, Ind.—W. S. Garritson is purchasing agent of the Knightstown Electric Light Company.

Rochester, Ind.—Edw. Beyer is president of the Rochester Electric Light Company.

La Salle, Ill.—W. A. Locke is secretary and treasurer of the Marquette Heat & Light Company and G. A. Wilson is purchasing agent.

Mendota, Ill.—L. R. Curtis is secretary of the Mendota Electric Light Company.

FINANCIAL.

ANNUAL REPORT OF WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.*

From the balance sheet it will be noted that the net profits from manufacturing and other sources amounted to $1,640,809.11 after charging to operating expenses, as heretofore large sums for alterations and additions to buildings, for maintaining the machinery and tools in the highest order, and all sums paid for interest and discount, excepting interest on bonds and scrip, which has been charged off direct to surplus. It will be seen that a large reduction in accounts payable, bills payable, issued for merchandise and those discounted with collateral, has been made from the profits of the company, which further illustrates the careful manner in which the officers of your company have conducted its business. By the recent sale at par of the preferred stock which was in the treasury of the company, the bills payable have been further reduced since March 31, so that on May 9 there were outstanding only $569,982.64 of bills payable of all kinds, of which $37,869.04 were issued for merchandise.

World's Fair lighting contract and exhibit.—The total received by the company from the World's Fair was $487,704.47. All goods shipped to the Fair were charged at the cost of labor and material with 20 per cent added. After charging the account with all costs of every nature in connection with the running of the plant and of the exhibit, and crediting it upon the return of the material with the net cost of labor and material, it shows a net cost to the company of only $16,013.03 for a grand display of the company's apparatus. The price at which the lighting apparatus used for exhibit has been sold, will yield a handsome profit to the company.

Niagara Falls power transmission.—The awarding to your company by the Cataract Construction Company, of the contract for three 5,000-horse power generators for the transmission of the power of Niagara Falls to Buffalo and other points, was an event of more than ordinary importance. The transmission of power by means of these generators, involves the use of your company's Tesla patents, covering the system of multiphase motors, and therefore the successful starting of this plant cannot fail to have a great influence in the development by your company of other plants for the transmission of power from waterfalls.

BALANCE SHEET, MARCH 31, 1894.

ASSETS.

Cash in banks			$325,694.55
Bills receivable			373,145.51
Accounts receivable			2,345 161.20
Material in stock and in process of manufacture (at cost of labor and material)			1,545,472.22
Advances to leased companies			109 121.68
Bonds (par value, $249 800)			237,397.15
Stock (par value, $6,489,400.16)			3,988,992.26
Real estate and buildings			464,403.48
Machinery and tools			886,452 67
Miscellaneous			66,339.07
Charters, franchises, patents, etc			4,379,831.69
Total assets			$14,722,314.48

LIABILITIES.

Accounts payable			$311,749 75
Bills payable, issued for merchandise			116 943 85
Discounted with collateral			69,300.00

Contract and Contingent Liabilities.

Script dividend			194,580 00
Stock subscriptions			13,125.00
U. S. E. Ltg. Co.'s 6 per cent 15 year bonds, $50,000 payable annually.			550,000.00
(Bills receivable under discount, $528,550.65)			

Capital Stock.

Preferred, 73,439.31 shares		$3,671 965 50	
Assenting, 103,309.62 shares		5,165,481.00	
Common, 3,583 shares		179,150.00	
			9,016,596 50
(In treasury 6,560.69 shares Preferred; and 13,107.38 shares Assenting.)			

SURPLUS.

Balance, March 31, 1893		$2,757,649.19	
Twelve months net earnings from business.	$1,610,504.66		
From other sources	30,304.45	1,640 809.11	
		4,398,458.30	
Less amount written off in adjustment of matters pending in 1890 and 1891	19,198.78		
Ditto in current year	252,323,20	271,521.98	
		4,126,936.32	
Interest on bonds	36,000.00		
Interest on script	11,673.72		
Dividends	257,213.22	304 886.94	3,822,019.38
			$14 722,314.48

Incandescent stopper lamp.—The successful use at the World's Columbian Exposition of the stopper lamps manufactured by your company, and their large use in general lighting, have fortunately placed the company in a position to protect all of its customers from the aggressive action of the owners of the Edison patent covering the all-glass globe form of lamp. A steady advance has been made in the method of manufacture so that your company is today producing a lamp which has no superior, and the use of which your officers expect to extend with great rapidity the coming season, on account of its quality and low cost of manufacture. Your officers believe that they will be able to sell stopper lamps to the company's customers at a price not exceeding the manufacturing cost of the all-glass form, and thereby greatly promote the company's electric lighting business.

New works.—In the last annual report your directors announced that they had accepted a proposition of the East Pittsburg Improvement Co. to erect, according to the plans of your company, a new manufactory on a site of 23 acres. In consequence of the general depression in business, the letting of the work was deferred until January, when contracts were awarded at very low rates, for the erection of a two-story machine shop, 750 feet long and 230 feet wide, a two-story warehouse, 750 feet long and 75 feet wide, and a boiler and power house, the whole having a floor space of over 10 acres. To these buildings there will be added in time a foundry, blacksmith shop and one or two other unimportant buildings, making the whole plant, when completed, a most comprehensive one in every respect. The new works will be completed and occupied during the present year, so that all the manufacturing will be concentrated, and large saving thereby effected.

In conclusion we call special attention to the exceptionally favorable position of your company with respect to the electrical trade. Its capital stock in proportion to its operations is small, and it has no contracts of any character with local lighting or other companies which can in any way interfere with the sale of its apparatus. It has a harmonious management, and has an unequaled reputation with respect to the design and character of its apparatus; so much so that the company's standard apparatus is purchased and paid for without special guarantees.

The business of the past month has been larger in volume than of the month previous, but the present month opens with less encouragement. The strike of the coal miners and many local strikes have added to the disturbing features of the situation. Trade shows little activity and orders are limited entirely to present demands. Cash seems to be the basis of trade everywhere, and prices seem but little if any better than in previous

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING May 25.
Miscellaneous Securities.						
American Bell Telephone Co	Stock.	$17,500,000	100	....	J. Q.	190
" " "	Bds. 1898.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co	Com.	14,000,000	100	....	....	85
Commercial Cable Co	Com.	7,716,000	100	....	....	120
Edison Elec. Ill. Co., Boston	Com.	2,025,800	100	....	F. Q.	115
" " "	C. Bds. 1898.	71,000	100	6	M. & S.	.....
" " "	C. Bds. 1901.	586,500	100	6	M. & N.	.....
" " Brooklyn	Com.	2,500,000	100	....	Q. F.	85
" " "	1st. 1940.	500,000	100	5	A. & O.	100
" " "	Regis.	....	100	5	A. & O.	.....
" " Chicago	Com.	3,000,000	....	8	Q. F.	135
" " "		2,500,000	....		....	.....
" " New York	Com.	7,938,000	100	....	Q. F.	100
" " "	1st 1910.	2,562,000	100	5	M. & S.	107
" " Phila	Com.	1,473,000	100	....	....	120⅛
" " "		....	....	5	....	.....
Fort Wayne Elec. Co	Com.	4,000,000	25	....	....	3¼
General Electric Company	Com.	30,457,000	100	....	....	38⅝
" "	Prf'd.	4,251,900	100	....	....	70
" "	Deb. 1922.	10,000,000	100	5	J.-D.	70
Gold & Stock Tel. Co	Com.	5,000,000	100	....	Q. J.	....
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	90
Thomson Elec. Welding Co	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	...	....	.....
Thomson-Houston Elec. Co	Series D.	120,000	10	....	....	5⅜
Thom'n-Houst'n Intern. Elec. Co.	Com.	600,000	100	...	....	.....
" " " "	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co	Com.	94,820,000	100	....	Q J.	82
" "	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	37
" " "	1st Pf. Cum.	3,755,700	50	7	....	52
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R	Com.	6,000,000	10	....	Q.-J.	170
" "	1st Bds. 1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R.	Com.	500,000	100	....	Oct. 1.	.....
" " "	1st Bds. 1909	300,000	100	5	J. & J.	.....
" " "	Certf. 1894.	300,000	100	6	J. & J.	.....
BUFFALO—						
Buffalo St. Railway	Com.	5,370,500	100	5	....	.....
" "	Bds. 1931.	5,000,000	100	....	F. & A.	.....
BOSTON—						
West End St. Railway	Com.	9,085,000	50	..	J. & J.	47
" "	Pr'f'd.	6,400,000	50	5	J. & J.	77
" "	Bds. 1902.	3,000,000	100	....	M. & N.	100⅛
LOUISVILLE—						
Louisville St. Railway Co	Com.	5,000,000	100	....	....	.....
" "	Prf'd.	1,000,000	100	5	A. & O.	.....
" "	1st Bds. 1930	6,000,000	100	....	J. & J.	.....
NEWARK, N. J.—						
Newark Passenger Railway	Com.	6,000,000	100	....	....	27⅜
" "	Bds. 1930.	6,000,000	100	5	J. & J.	84½
NEW YORK—						
Union Railway Co	Com.	2,000,000	100	....	....	155
" "	Bds.	2,000,000	100	....	....	.....
PITTSBURGH—						
Duquesne Traction Co	Com.	3,000,000	50	...	....	27½
" "	Bds. 1930.	1,500,000	100	5	J. & J.	100
Fed. St. & Pleas. Val. R. R	Com.	1,400,000	50	....	J. & J.	20
" " " " "	Bds. 1919.	1,250,000	100	5	J. & J.	100
Pittsb'gh, Aleg. & Man. R. R	Com.	3,000,000	50	....		41
" " "	Bds. 1931.	1,500,000	100	5	J. & J.	100
Pittsburgh & Birming. R. R	Com.	3,000,000	25	....	....	12½
" " "	Bds. 1929.	1,500,000	100	5	M. & N.	95
ROCHESTER—						
Rochester Railway Company	Com.	5,000,000	100	...	....	67
" " "	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway	Com.	2,500,000	100	....	Q. J.	72½
" "	Bds. 1910.	1,500,000	100	5	J. & J.	100
St. Louis & Suburban	Com.	2,500,000	400	....	....	30
Union Depot Railway	Com.	1,200,000	100	....	....	.....
" " "	Bds. 1910.	1,000,000	100	6	A. & O.	91

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* Abstract of Report.

months. The stock markets are extremely dull and prices in general have ruled several points lower. Standard commodities are at the bottom figure and business men in general have made up their minds that business is not going to assume firmer proportions immediately. However, it is on a sound basis with a currency of which there is no question. The tariff question, it is hoped, will at no distant day, be settled, but of that we have no assurance. Congress seems to get from one tangle into a worse one and at the present time seems no nearer a solution than six months ago. Electrical stocks remain about as one month ago. Westinghouse is strong and it is reported that a dividend will probably be declared the coming year on the common stock.

The Nash Scientific Paints.

An important attribute of every structure is its durability. As nature builds up it also destroys, and aided by the waste of modern civilization, the destruction is much more rapid than formerly. To protect the work of mankind from the action of the elements has been a study to which men have given close attention. To meet successfully the problems that arise requires a thorough knowledge of the sciences.

The work of Mr. F. J. Nash in endeavoring to find a means of protecting structures of the various kinds from the action of the gases and acids that fill the air and ground, resulted in the production of the Nash Scientific Paints. So-called, because their composition was founded upon scientific principles which were applied in a practical manner in the solution of this problem. The plan of applying one coat on another which formerly resulted disastrously by the whole peeling off is entirely guarded against. This paint has a natural affinity for the material on which it is applied, so that it cannot be removed unless the surface of the metal is removed. On wood it goes down into the grain and gets a firm hold and also seals up the pores.

By the use of the insulating paint the electrolysis of metals underground is prevented. The pipes or metal work being given one careful coat of metal paint, one coat of insulating paint and a coat of the underground paint, the metal is thoroughly insulated and protected from any future effect of the electric current. For switchboards or woodwork of any kind the insulating paint has been successfully used. These paints, which include the paints for buildings, the special paints for machines, dynamos, etc., the insulating paints for switchboards, for underground work, etc., are all made from Mr. Nash's inventions which are the results of scientific principles practically applied. They have been given a number of years of service showing that they are all that is claimed for them. When applied they form an armour which is a part of the surface of the metal or wood and which affords an ample protection. A large stock of these paints is handled by Chas. E. Chapin, selling agent, at 136 Liberty St., New York.

NEW BOOKS.

How to Make and Use the Telephone, by George H. Cary, A. M. Lynn, Mass., 1894. Bubier Publishing Company. 120 pages illustrated. Price, postpaid, $1 00.

This work has been compiled for the use of those who desire a knowledge of the construction and operation of the simpler forms of telephones and telephone systems. It is specially adapted to the wants of the amateur. No attempt has been made to give an exhaustive treatise on the subject, but rather to touch upon those points of practical information which are of most use to the amateur or the unprofessional user of telephones. The instruments and systems described are illustrated by cuts, making their construction clear to the reader. To this elementary treatise there is added an appendix in which the Gibboney long distance telephone system is described, the construction of a simple phonograph and an abstract of a lecture by Prof. Puffer on the telephone.

Electrical Measurements for Amateurs, by Edward Trevert, 1894, Lynn, Mass. Bubier Publishing Company. 120 pages illustrated. Price, postpaid, $1.00

As the name indicates, the author has intended this book for the amateur and those whose study of electricity has been limited. For those who desire an insight on the subject, or whose experimenting requires making measurements of the different factors, this volume will be found very useful. Many difficulties appear in experimental work to those who have not been in a position to acquire a practical and thorough knowledge on the subject. It is the object of this book to clear away some of these difficulties. The necessity of exactness in making measurements of electrical quantities, makes the first chapter especially interesting, being devoted to electrical units, the standards from which the commercial units are taken. The subject is very clearly treated: technical language, such as would not be understood by the average reader, is entirely omitted. Illustrations also serve to explain the construction and operation of the instruments.

TRADE PUBLICATIONS.

A small pamphlet issued by the Independent Electric Co., of Chicago, gives information respecting fuse wires, etc. The tables give sizes, lengths, carrying capacity, weight and price of fuse wires and links. The illustrations show the various forms and styles of fuse links. Several pages of descriptive matter, and an article on "Safety Fuses," by Chas. A. Pratt, complete the contents. It is very nicely printed and bound in a neat cover.

A pamplet headed "More Light on the Subject" has been received from the Southern Electrical Manufacturing and Supply Company, limited, of Baronne street, New Orleans. The advantages of the electric light is set forth in the words, "cleanliness, safety, convenience and economy." The users of apparatus, furnished by the company, by means of letters which are compiled in this little volume furnish some very effective testimonials of the satisfaction which the various plants are giving. The Southern company is well known throughout the South, and the letters of its customers speak well for its success. The industries using the electric light are those that are the most important of the South.

A nicely gotten up engine catalogue has been sent out by The Weston Engine Company, of Painted Post, N. Y. The engine is very clearly illustrated by cuts which show to advantage the special features of the engine. The details of the different parts are shown by the smaller cuts. A full and carefully prepared description accompanies the cuts. The description covers the different parts of the engine in order and the various sizes of engine are tabulated, giving the horse power and dimensions of various parts. The catalogue is nicely printed on fine paper, bound in handsome embossed covers, and will present to the trade in a satisfactory manner, these engines which for several years have been making their way among power users.

From Chas. A. Schieren & Co., of New York and Chicago, an eight page circular has been issued containing some half-tones showing a number of great belts shipped to various central stations and power-houses. The results of a series of tests are given of leather cut from different parts of the hide. A diagram of a hide shows the location of the different pieces. The pieces were each cut 18 inches long and two inches wide. Upper part of shoulder broke at 1,130 pounds; lower part of shoulder, 1,390 pounds; upper part of butt, 2,000 pounds, and lower part of butt, 2,490 pounds. The test was made by the Fairbank's Scale Company in New York. The importance of using only the prime part of the hide, the well-known "perforated" and "electric" belts are all made from the center pieces on each side of the belt which not only gives a strong and durable belt, but one that keeps its shape and runs even.

Among recent catalogues received is one from the Emerson Electric Manufacturing Company of St. Louis, which is devoted to the Meston alternating current motor. This motor has been before the trade for some time and, being constantly improved and applied to new uses, it appears this year under new colors. The motor, as designed for driving fans, is a standard commercial article requiring only to be connected to the circuit when it runs without care. This, however, is but one application of the motor, as it is as readily used for driving sewing machines, dental outfits or any of the numerous places where a small amount of power is desired. The catalogue has been made up in an excellent manner. The special points of interest are given prominence and the entire subject is treated in a comprehensive manner. The cuts illustrate very clearly the different applications of the motor and various appliances used therewith.

A recent pamphlet issued by the Harrison International Telephone Construction Company, is devoted to the legal side of the telephone. Numerous opinions from prominent patent attorneys are given, and a brief history and favorable termination of the only suit for infringement filed against the company. The above suit was filed in the United States Circuit Court for the Northern District of Arkansas in 1889 for infringement by Dr. Harrison and others who were using the telephones at Fort Smith. After a large amount of testimony had been taken, the suit was withdrawn and the costs settled by the plaintiffs. Since that time the Harrison telephone has been in satisfactory use in many towns and cities. Some of the causes that lead to the organization of the Harrison company are also described. In discussing the growth of the telephone business it says: "During the life of the original telephone patents more than one hundred millions of dollars were invested in telephones in this country. The gross revenues from this enormous capital it is difficult to estimate, but it amounts to a large annual per capita tax, greater than that imposed by the demand for illumination, whether by gas or electricity." Many facts concerning the Harrison telephone are also given in the pamphlet.

Vulcanized fibre has made an extensive field for itself among manufacturers, and especially among manufacturers of electrical goods. The ease with which it is worked is a point in its favor. It can be worked in a lathe, drilled, rivited, sawed or punched and receives a fine polish. It is an excellent insulator and is largely used as a substitute for hard rubber. On dynamos between commutator segments, magnet heads, for switch boards and switch plugs, wall insulators and the bases for telegraph and electrical instruments, and hundreds of small appliances and devices, it is now extensively used. A pamphlet issued by the Vulcanized Fibre Company, of No. 14 Dey St., New York, contains considerable information in regard to what is now an important industry. The various uses to which this product is put are explained and price lists are given. The vulcanized fibre is made in three colors, black, red and gray. Another product which is being used is graphoid fibre, a material composed of fine graphite and fibre which makes an excellent material for washers, journal bearings, etc.

PERSONAL.

Mr. J. S. Crider, secretary of the Washington Carbon Company, Pittsburg, Pa., visited Chicago last month in the interests of his company.

Mr. W. H. Lahman, the manufacturer of the Lahman-Kirkwood grate bar has just returned from a trip South for pleasure and his health.

W. H. Gibson, Chicago, the western manager of I. B. Davis & Son, manufacturers of the well-known Berryman feed water heater, has removed his office to 520 Medinah Bldg.

Mr. M. M. Hayden, president of the Hayden-Booker Manufacturing Co., and Mr. S. G. Booker, of the Fidelty Carbon Manufacturing Co., of St. Louis, were in Chicago on business last week.

Mr. P. H. Alexander, whose name has been known in the electrical business from almost the inception of the industry, is now manager of the light and power department of the Electric Selector & Signal Co.

Prof. George Forbes, consulting electrical engineer for the Cataract Construction Company, made Chicago a visit the middle of the month, arriving on the 16th with his cousin, the Countess of Glasgow, who is on her way home from New Zealand.

Mr. Chas. F. Foster, who was formerly connected with the World's Columbian Exposition as mechanical engineer, has recently opened an office in the Manhattan building, Chicago, to carry on a general engineering business. His previous connections and large acquaintance will undoubtedly secure an extensive patronage.

Mr. James R. Chapman, manager of the Consolidated Street Railway Company, of Grand Rapids, has accepted the position of manager of the North and West Chicago Street Rys. Mr. Chapman has had considerable experience in the management of street railways, and his experience during the installation of the electric system in Grand Rapids, will be of service during the contemplated improvements in the Chicago railways.

BUSINESS NOTES.

Chas. A. Ccheren & Co., New York and Chicago, has just received an order from the Brooklyn City R.R. Co. for an extra belt 91 feet long and 60 inches wide for its power plant.

Mr. C. E. Lee, Chicago, is now located in the new Medina building at the corner of Jackson and Fifth Ave., where he is handling a full line of batteries, motors and house goods.

Mr. Wm. H. Bryan, Turner Bldg., St. Louis., recently prepared the plans and specifications for the lighting plant for the city of Hawarden, Iowa. The contract has just been awarded under very favorable terms.

Osburn Brothers, Chicago, are just moving into their new quarters at 304 Dearborn St., where they are placing a new stock of general electrical supplies. The new location will give them better advantages for the sale of supplies and the variety of specialties which they carry.

Ahearn & Soper, Ottawa, the Canadian agents of the Westinghouse Electric & Mfg. Company, are installing the electrical equipment of the Galt & Preston Street Railway, of Galt, Ont. There were four competitors for the contract, but it was carried off by this enterprising firm.

The Adams & Bailey Electric Co, Elkhart, Ind., has enlarged its factory and put in new equipment, which now places the company in an excellent position to handle its present and future trade. The improved transformer has been well received and the indications point to a large demand for them.

Chas. A. Schieren & Company, New York and Chicago, has received among recent orders one from the Metropolitan Street Railway Company, San Francisco, Cal., for 75 feet of 34 inch double perforated electric belting. The order is awarded to the company after a number of years of experience in the use of belting.

The Chicago Insulated Wire Company is now located in its new office at 414 and 416 Northern building, Chicago, and is carrying a large stock of the various kinds of wire in Chicago to accommodate its customers with immediate shipments. The factory at Sycamore, Ill., is turning out a full line of wires in the various sizes and the Chicago stock will accommodate any orders.

The Western Telephone Construction Company, 540 Monadnock Block, Chicago, has just completed the installation of the following exchanges, all of which are now in excellent working order and are giving first-class satisfaction. The list for May includes Beaumont, Texas; Russellville, Ky.; Albert Lea, Minn.; Greensboro, N. C.; Waxahachie, Texas; Santa Fe, New Mexico; Petaluma, Cal., and Manistique, Mich.

The National Water Tube Boiler Co., New Brunswick, N. J., held its annual meeting at its main office on the 16th. While the financial depression checked the output for the summer months, yet the business of the later months reached nearly that of recent years. The reports of the officers were most satisfactory to the stockholders. A dividend of 5 percent was declared on each share of stock, which left a surplus in the treasury for future contingencies.

The W. S. Hill Electric Co., Boston, Mass., has shipped during the past month two orders for switches to one company that weighed over 11 tons, and notwithstanding the hard times the sales of the company for the past nine months have averaged nearly 75 per cent more than for the corresponding months of a year ago. Such a record is an exceptionally good one and is an indication of the character of the goods manufactured, which are always in demand.

The Manhattan General Construction Co, 50 Broadway, N. Y., has had a large demand for the Fleming dynamo brush, which is now used by the United States, English and Brazilian governments. The brush is made up of a continuous strip of gauze, and by the process of manufacture is made to wear uniformly throughout its entire length, with no unraveling of the gauze and no sparking from loose ends. It has proved satisfactory in efficiency and durability to users, and is an addition to the supplies handled by the Manhattan company.

The McLean Armature Works, 197 So. Canal St., Chicago, are now operated by the copartnership of James McLean, George T. Heald and John S. Parmele, the firm of McLean & Adams having been dissolved by mutual consent. The new firm assumes all debts and obligations as well as all accounts of the old firm. The name of McLean Armature Works is well known in the trade and under the direction of the new management its field will undoubtedly be greatly extended. The rewinding of armatures and the repair of electrical machinery has become a specialty with the company.

The Western Electrical Supply Co., 911 Olive street, St. Louis, Mo., is one of the most enterprising supply houses of the west and controls a large trade in the south and southwest. Among orders of the past few days is one for an arc-lighting plant for Ponca, O. T., which indicates only one branch of its trade. Its salesrooms are considered headquarters for supplies of all kinds. The Western incandescent lamp is sold in large quantities, and large and small orders for Clark wire keep that department busy. The company has recently placed on the market a complete telephone system, and among the exchanges being put in is one at Mexico, Mo., with 50 subscribers. The company, by virtue of its long standing and extended experience, is able to supply orders for any kind of electrical apparatus and carry a complete stock of standard supplies.

The Westinghouse Electric and Manufacturing Company has moved its Chicago office from the Pullman building to the new New York Life building on the corner of La Salle and Monroe Sts., where very pleasant offices have been secured.

The Akron Belting Company, Akron, Ohio, has filled many orders recently for its "dynamo" belting. These belts are made with special reference to this kind of service. They are made very flexible for the high speeds and being well stretched are most efficient in service.

Kohler Brothers, the western representatives of the Walker Manufacturing Co., of Cleveland, O., and the Eddy Electric Mfg. Co., of Windsor, Conn., now occupy offices at 1644 1648 Monadnock Block. A good prospect of a fair season of business is reported. Although generally quiet, by keeping in touch with the trade they hope to secure a fair share of business.

Castle, Hays & Co., 248 Sixty-second St., Englewood, is the successor to the firm of Bateson & Hays, which has for some time been engaged in electrical construction work. The firm has installed a large number of plants in Chicago and vicinity, and the new firm continues the construction work and adds a line of supplies. The headquarters are very favorably situated, and this part of the city will undoubtedly afford a very good trade.

The Chicago Rawhide Manufacturing Co., Chicago, in order to accommodate its growing business, has just opened up a store in Boston at 191 and 193 High St., where it will carry a full line of all kinds of rawhide goods, including dynamo belting, bell and register cords, sample pinions for gears. straps, harness goods, etc. The store is in charge of Mr. John T. Emery. This company reports its business as improving, and looks for further material improvement during the next few weeks.

The Solar Carbon & Manufacturing Co., 95 Fifth Ave., Pittsburg, has secured the right to manufacture the wire gauze carbon brush. This brush is composed of carbon and metal alternately. It has both the advantages of the conductivity of the copper and the lubricating qualities of carbon and graphite. It is claimed for these brushes that they possess greater conductivity, lower resistance, longer life and a clean bright commutator. This specialty with the precedence the company possesses should receive a large demand, as it will undoubtedly as soon as its qualities are understood.

Cushing & Morse, Chicago, the western agents of Kerite wires and cables, have just received an order from Mandel Bros. for wire to rewire their entire building. This order is particularly gratifying to the firm for the reason that it came without solicitation. This firm also received a few days ago an order for a new telephone sub-marine cable two and one-half miles in length for the city of Chicago, to be used to reach one of the cribs in Lake Michigan. This order is a duplicate of the cable furnished the city for the four mile crib some time ago. A number of other large orders for wire have also recently been received.

The Central Electric Company, 173 Adams St., Chicago, is rapidly putting the finishing touches to its new quarters, which are in every way convenient for the transaction of business. The Lundell motors are going to all parts of the United States, being one of the best known fan motors on the market. The new ones for this season have a number of improved features. The sales of Okonite wire and interior conduit, two of the standard commodities handled by this company, are keeping up to those of previous months. Telephone supplies have been in great demand and this company is looked upon as headquarters for all supplies of this kind.

The Metropolitan Electric Co., 186 Fifth Ave., Chicago, reports a very lively trade during the past month. The well known brand of wire handled by the company, N. I. R., is in as great demand as ever, while the general supply trade has shown as great activity as any time during the season. The fan motors have been in great demand and with the large stock on hand the orders are being promptly filled. The P. & B. products receive a continuous demand and a large stock being carried the customers at a distance as was as in the vicinity of Chicago know that their orders will receive prompt attention. The Metropolitan incandescent lamp continues to be a favorite.

The Brown Electric & Machine Company, Little Rock, Ark., which recently filed articles of incorporation, succeeds the Arkansas Electric Supply Company. The officers of the company are, president, J. T. Brown; vice-president, W. G. Brown; secretary and treasurer, R. S. Buck and superintendent, F. K. Fassett. The addition of new material and better facilities places the new company more actively in the field. Mr. R. S. Buck, the new member of the company, was formerly a civil engineer of New York but comes highly commended as to his ability and energy. A large southern trade is promised the company and the energy of the company will soon show itself.

The Electric Appliance Co., 242 Madison St., Chicago, is placing on the market a complete magneto-telephone system for private lines, office and factory exchanges. A new catalogue of the system will be off the press shortly. The few days of warm weather sent in a number of orders for Meston fan motors, which are always carried in stock. In the show windows there was recently placed a display of Carpenter electric heating and cooking appliances which has attracted considerable attention. The Acme expanding wire guard for protecting incandescent lamps is another of the specialties which the company is carrying in stock. The Globe net for arc lamps is also carried in stock.

T. C. Rafferty & Co., 323-325 Dearborn St., Chicago, Ill., have just been appointed general western agents for the New Beacon incandescent lamp, manufactured by the Beacon-Vacuum Pump & Elec. Co., of Boston, Mass. This well-known lamp is all that is claimed for it by its manufacturers in efficiency and longevity, and is in addition a non-infringing lamp. Messrs. Rafferty & Co. have also secured the general western agency for the well-known and justly celebrated Bishop white-core rubber-covered wires and cables, a full stock of which, in all sizes is carried in Chicago. Every central light station and electrician should have a new copy of their price list, which is just off the press.

Mr. Hugo Reisinger, 38 Beaver St., New York, calls attention to the following paragraph in an article by Prof. H. S. Carhart: "The days of cheap and inefficient carbons should soon be passed, for wherever a highly efficient service is desired, instead of merely a cheap, it is of the utmost importance to use the best carbons obtainable. Central stations which have adopted the "Electra" carbons have found an immediate change in the service given, and it is considered strange that cheap and imperfect carbons can find a sale. Mr. Reisinger has given particular attention to the carbon trade, and has met with success in the the importation of the high grade Nuremberg carbons, which received a premium at the World's Fair."

The Muncie Electrical Manufacturing Company is the name of the new company which has obtained control of the late Muncie Electrical Works, of Muncie, Ind. The new company is now able to fill any and all orders for electrical machines of the Muncie type which are already well known to the trade. The company is well equipped for turning out a full line of constant potential motors or incandescent dynamos. Mr. Fred Van Namee is in control of the company and will endeavor to establish the reputation of the Muncie machines, which will be turned out with the utmost care and allowed to leave the works only after being subjected to severe tests. The affairs of the company will be conducted in accordance with strict business methods and the company which now starts out with new strength will undoubtedly meet with success.

The McLean Armature Works, 197 So. Canal St., Chicago, has been making many improvements since the change in the proprietors. The interests owned by Mr. W. H. Adams were purchased by Mr. George F. Heald and Mr. J. S. Parmele. Mr. James McLean, who is the senior member of the firm, was for years connected with the Excelsior Electric Co. as expert electrician, and superintended the construction of many important plants throughout the country, and in his varied experience has become thoroughly familiar with all kinds of apparatus Mr. George F. Heald was formerly treasurer of the American Bronze Co., which has executed many important pieces of work Mr. John S. Parmele was up to May 1 connected with the Great Western Manufacturing Co., and is thoroughly acquainted with the electrical trade. The firm started about two years ago under the name of McLean & Schmitt, and has steadily increased its business. The firm has made a specialty of winding armatures, fields, transformers and the repair of commutators, arc lamps, etc.

The Chas. E. Gregory Co, 47 S. Jefferson St., Chicago, is having a very brisk season of business, as shown by the following list of sales: Jacksonville Gas Light & Coke Co., 2-horse power Crocker-Wheeler motor; T. W. Webster, Bay City, Mich., 10-horse power Jenny motor; Four Lakes Light & Power Co., Madison, 3 horse power Eddy motor; L. H. Bronson, Chicago, 2-horse power Eddy, 5-horse power Westinghouse; C. E. Woodruff & Co., Chicago, 30 K. 2 T.-H. arc lamps; Western Telephone Cons. Co., Chicago, 5-horse power Siemans dynamo; Perkins & France, Chicago Heights, 150-light Edison dynamo; J. M. Lee, Superior, Neb., 30-light Sperry arc dynamo and lamps; Omaha Elec. & Mfg. Co., Omaha, 1-horse power Jenny motor; Bay County Electric Co., Bay City, Mich., 200-light Westinghouse dynamo; Madison Light & Power Co., Chicago, 30 light Sperry arc dynamo and lamps; Lewis Rice, Philadelphia, 15-horse power Sprague motor; C. & C. Electric Motor Co., Chicago, 30-light Sperry arc dynamo; Gault House, Chicago, 20 K. W. C. & C. generator; Leonard & Slater, Chicago, 10 horse power T.-H. motor; Wells Goodhue, Chicago, 10-horse power Rockford motor; National Type Foundry, Chicago, 4-horse power Edison motor; Taylor, Dee & Mack, Chicago, 1-horse power Perrett motor; Victoria Hotel, Chicago, 3-horse power Detroit motor; Saratoga Hotel, Chicago, 2-horse power Detroit motor H. I. Kimball, Chicago, 3-horse power Eddy motor; M. Helgen, Butte, Mont., 2-horse power Crocker-Wheeler motor; Antigo Edison Co., Antigo, Wis., 15-light arc plant; W. T. Osborne, Kansas City, Mo., 2-horse power Detroit motor; E. H. Dow, Sioux Falls, S. D., 2-horse power T.-H. arc motor; U. S. Artillery School, Ft. Monroe, Va., 12-light T.-H. arc dynamo and lamps; W. W. Low, Chicago, 50-light Westinghouse dynamo; P. J. King, Chicago, two 1-horse power Crocker-Wheeler motors: Norton Bros., Chicago, 200-light Westinghouse plant; Monarch Refrigerating Co., Chicago, 150-light Westinghouse plant; M. J. Steffens, Chicago, 40-light Crocker-Wheeler dynamo. During the recent hot spell 93 fan motors were sold in precisely eight days. The firm also reports a brisk business in odd instruments, arc lamps and ventilating apparatus.

ELECTRICAL INDUSTRIES.

Vol. V. CHICAGO. July, 1894. NEW YORK. No. 7.

The Hammond, East Chicago & Whiting Electric Railway.

The immediate vicinity of Chicago, in which there are many rapidly growing suburbs, has witnessed considerable activity in railway construction during the past two years. Street railways now radiate in every direction to points fifteen and twenty miles distant from the city. Although their advance has encroached upon the traffic of the steam roads, and has therefore met great opposition, yet the enterprise of the managers who have confidence in the future of this region, has boldly carried forward these projects. Capital has been readily secured for the construction of the lines, perhaps more readily since the railway field in the larger towns and cities has been well covered and suburban and intersuburban lines offer the most favorable opportunities for investment.

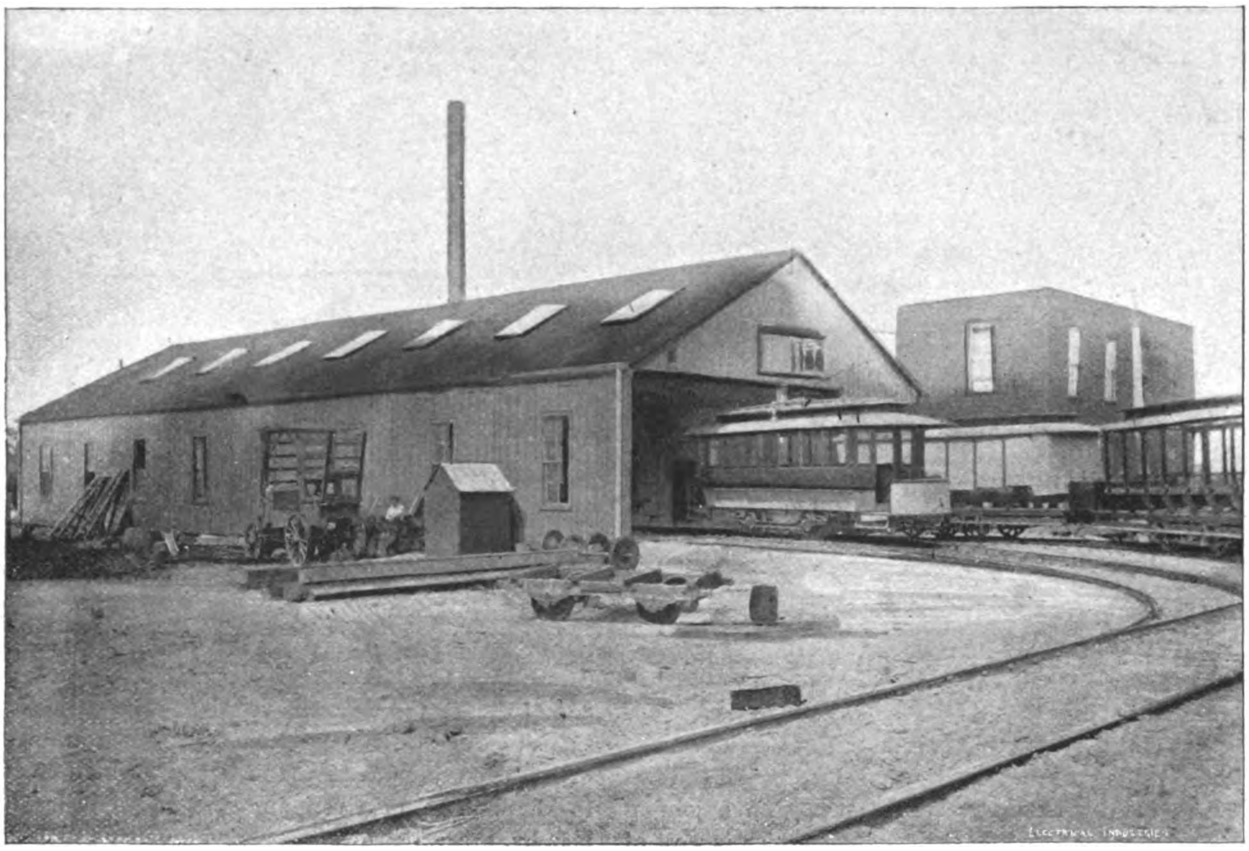


FIG. 1.—THE HAMMOND, EAST CHICAGO & WHITING ELECTRIC RAILWAY.

One of the interesting intersuburban lines, which are of recent construction, is that which connects Hammond, South Hammond, East Chicago, Whiting and Robey. It also connects with both the South Chicago and Calumet electric railway systems, over which passengers may reach Chicago. This region has a population of about 75,000, and contains many important manufacturing establishments furnishing employment to many workmen who are patrons of this line. There are on the line race tracks, ball grounds, picnic and pleasure grounds, and cemeteries, which bring the road considerable traffic. The excursions and picnic parties from the towns and cities are of frequent occurence, which, together with the sightseers make a pleasure line of this road. The road has gradually been built up and further extensions are to be made.

The road is capitalized at $200,000, and is owned by the Hammond & East Chicago Electric and Street Railway Company. The president of the company is Mr. Chas. F. Griffin; vice-president, Mr. N. M. Kaufman; secretary and treasurer, Mr. A. Murrey Turner; the superintendent and purchasing agent is Mr. W. E. Muir. The offices of the company are at East Chicago, Ind. The country through which the road runs is level, sandy, and in some places low. There are no grades, few curves and an exceptionally even track. The roads, except on the principal streets of the town, are unimproved, and in the construction of the track many places required considerable filling. No heavy work was encountered, and with the exception of the bridges, the line had excellent advantages for rapid construction. The track is standard gauge. Cedar ties, 60-pound T rails, and 76-pound girder rails were used in its construction. The rails were bonded and cross bonded, and anchors were placed in the creeks the road crosses. A single overhead trolley is used. The trolley wire is suspended in the usual manner. The poles have been well selected and above the portion which was pitched before being placed in the ground, are painted white. Through sections where the soil is light, the poles are held in position by guy wires fastened to "dead men." The company is now operating six motor cars and three trailers, and will soon have six more in service. These cars are from the Le Clede Car Company, of St. Louis, and from the Pullman's Palace Car Company, and are equipped throughout with Westinghouse apparatus. The motors, controllers, etc., are of standard type and have proved very efficient in service. The cars have every modern improvement including New Haven registers. The trailers are especially attractive in appearance, being open cars neatly finished and provided with roller curtains that exclude the sun and rain or are easily raised for sightseeing. The seats are reversible, and the cars are especially well adapted for excursions. The car schedule is arranged to accommodate the traffic of the day, and for special occasions a special service is provided.

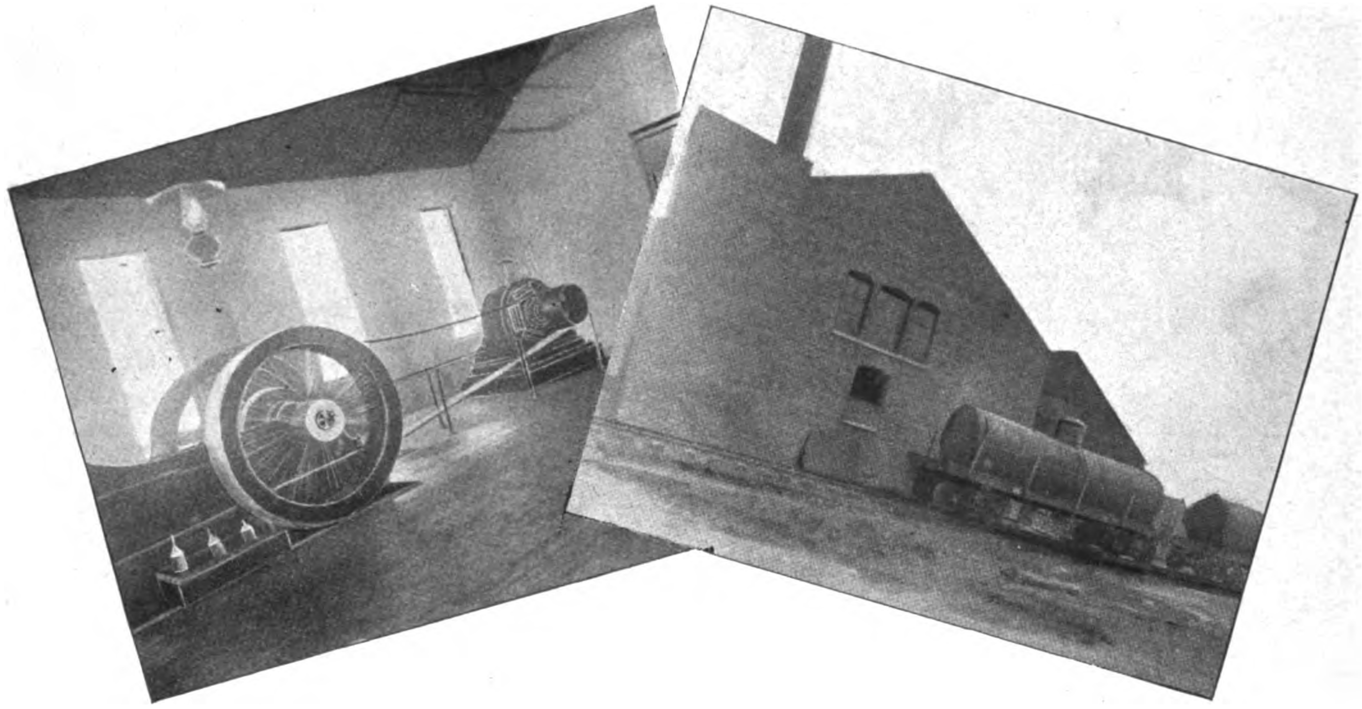


FIG. 2.--THE HAMMOND, EAST CHICAGO & WHITING ELECTRIC RAILWAY.

The power plant as well as the car barns and offices of the company are located at East Chicago, which is centrally located in respect to the line. The power house is of brick construction, 49 by 100 feet, with trussed roof. The walls and ceiling are high giving good light and ventilation. The store rooms and offices occupy an adjoining building 50 by 50 feet, and the car barn, which is west of the power house, is 210 by 44 feet; it is strongly built, fire proof, and contains four tracks. The tracks are laid on stone foundations, and pits are provided under each. The trolley runs over each track, so that each car can be quickly and easily run out or in. The boiler room, which is next to the engine room, contains at the present time two 80 horse-power Erie Engine Company's boilers and two 120 horse-power are about to be installed. Crude petroleum is used exclusively for fuel. A 300 barrel tank is located about 200 feet from the boilers from which the oil is pumped to the burners. A siding runs to the tank so that the oil is delivered to the tank into which it runs by gravity from the tank cars. The company is well satisfied with this fuel and has had sufficient reason to congratulate itself during the recent strike of the coal miners. The boilers require little attention, and the force required at the power house is consequently small. The engine room, which is large and well lighted, contains one 250 horse-power Ball Engine Company's engine with cylinder 16 by 18, which is belted to a Westinghouse four pole generator of 250 horse-power. Preparations are being made for a 300 horse-power engine and generator of like size. The present equipment is operated continuously and is hardly large enough for the present traffic on the road, and will be inadequate as soon as the rolling stock arrives. The company is also without protection should an accident occur to this generator or engine. The exhaust steam passes through a Berryman feed water heater, which purifies the water and utilizes the heat of the exhaust steam.

The switch board is well equipped with instruments, lightning arresters, etc., which are of Westinghouse manufacture. The instruments and terminals are well insulated and all wires are run back of the board, giving the face a neat appearance. The feeder cables are run from the station on a well erected line to the road where they are carried on the poles. The draw bridge at Hammond, across the Grand Calumet, required a special construction to enable the bridge to be opened without breaking the circuit. The cable was placed in wrought iron pipe and sunk to the bottom of river, and the banks being low and marshy, excavations were made on each side to a sufficient depth to prevent the pipe being injured. A special connection was devised by the lineman to allow the bridge to be opened, and when closed should give a continuous trolley wire across the bridge. This device has performed the service perfectly. The cables on each side of the river are run into special boxes, where it is connected through fuse block to the feeder cable and the trolley wire.

The territory now covered by this railway will undoubtedly be rapidly developed. The manufacturing establishments which are now located here are permanent, and the number will increase rapidly, giving the road a greater patronage and permitting it to extend its lines to other neighboring points. The company now possesses franchises to Englewood and other points that will more than double its present territory.

An Optical Phase Indicator and Synchronizer.*

BY GEORGE S. MOLER AND FREDERICK BEDELL.

In starting a synchronous alternating current motor it is usual to bring the motor up to speed by some external means, and to switch it into connection with the generator when the motor and generator are running synchronously, but are in opposite phase. Various devices have been employed to indicate synchronism and to show when the motor is in opposite phase to the generator, one of the simplest of these devices consisting of an incandescent lamp used as a pilot lamp. The lamp is connected directly in the circuit supplying the motor, so that all the current through the motor armature passes through it. Before the motor is started the lamp glows steadily. As the motor attains considerable speed, the lamp suddenly flashes up and dies out alternately, according to whether the electromotive force generated by the motor, and the electromotive force from the alternator are in the same or in opposite phases. Beats are thus produced which occur at longer intervals as the motor approaches synchronism with the alternator. When the intervals are long enough to be quite marked, the motor is connected directly to the generator circuit by cutting the lamp out at a moment when it is dark, indicating that the machines are in opposite phase. At the same time the external power, which has driven the motor to synchronism, is removed. Instead of one lamp, several lamps or a lamp together with dead resistance may be used where required.

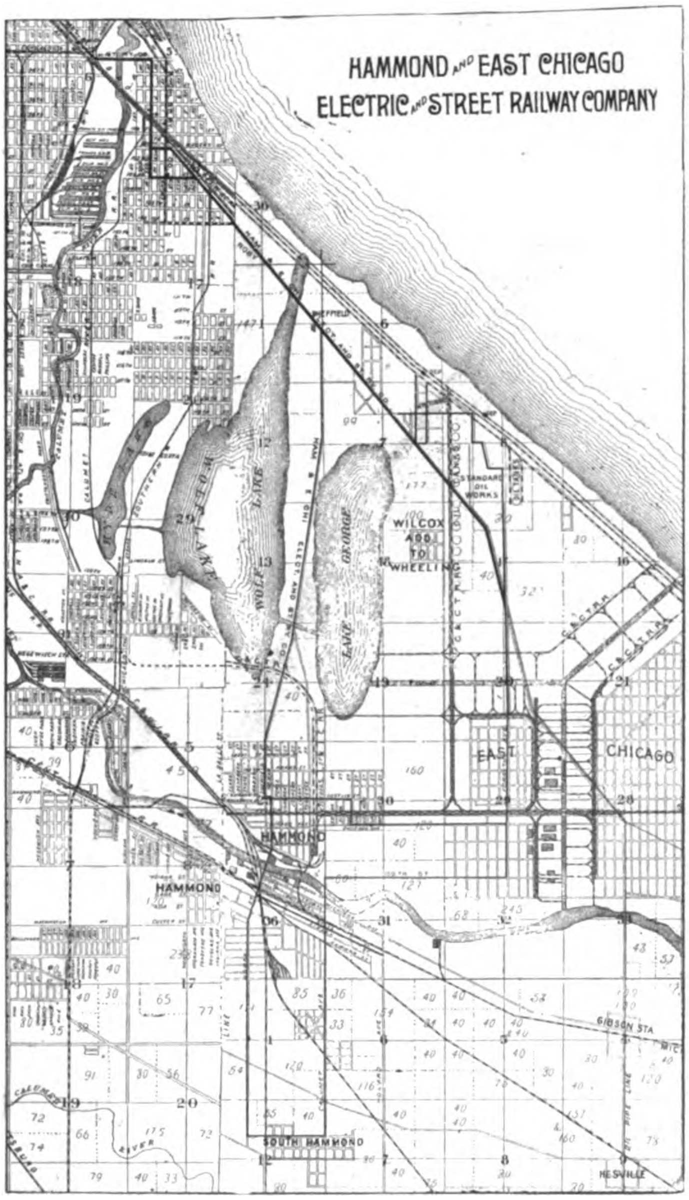


FIG. 3.—HAMMOND EAST CHICAGO & WHITING RAILWAY.

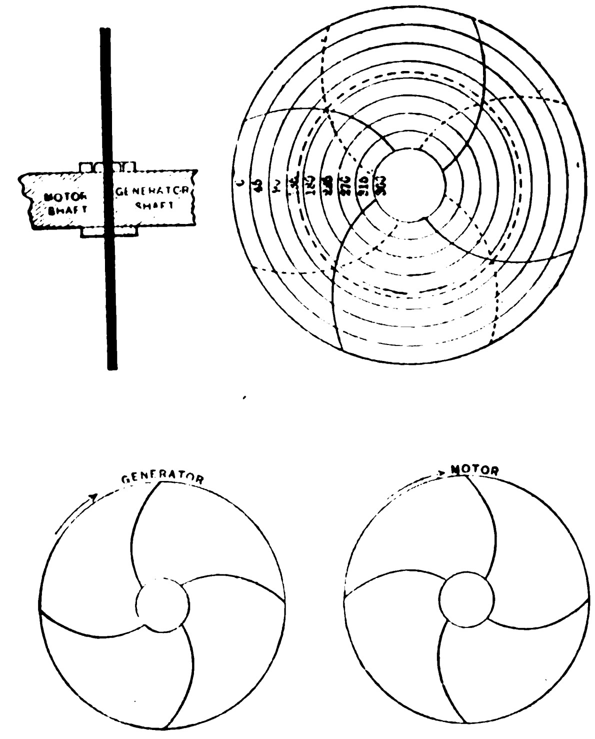
This device is simple and efficient. It does not, however, indicate the moment when the exact synchronism is reached, nor does it show whether the motor is running at a greater or less speed than that corresponding to the generator. It does not show the exact phase difference between the motor and generator, and does not indicate the phase relations after the motor has been connected to the alternator and is being driven by it.

The following instrument has been devised by the writers to give definite information in regard to the relative speeds and phase positions of the motor and generator in laboratory investigation. It shows

(1) When the machines are synchronous;

(2) Which machine is running the faster when they are not synchronous;

(3) The angle by which the motor lags behind the generator.



FIGS. 1, 2, 3 & 4.—AN OPTICAL PHASE INDICATOR AND SYNCHRONIZER.

We will first describe the simplest form of the phase indicator. The motor and generator are placed together with shafts in line and abutting, but not quite touching. The two machines must have the same number of poles, so that a revolution of the armature of each represents the same number of alternations. The abutting ends of the shafts carry two discs, one connected rigidly with the motor armature, the other similarly connected with the armature of the generator, as shown in Fig. 1. In these discs are curved slits, one slit for each pair of poles of the machines. These slits are shown in Fig. 2 for an eight-pole machine. The two discs are in every way similar, the one being the reverse of the other. The two discs are practically superimposed, and together form one disc with four holes, where the slits of one disc cross over the slits of the other. Evidently the distances of these four holes from the center depend upon the relative positions of the two armatures; they move in and out as the armatures shift their relative positions. From the symmetrical arrangement of the slits, if one armature is stationary and the other is moved past two pole pieces or through 90 degrees of arc (corresponding to a complete period of alternation, or 360 degrees of phase), the intersection of the slits will be the same distance from the center as before. The curvature of the slits is such that the distance to or from the center that the intersections of the two sets of slits move is proportional to the change in relative position of the two armatures.

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*Presented at the Philadelphia meeting of the American Institute of Electrical Engineers.

When the two armatures are running at the same speed in the same direction and there is a source of light on one side of the discs, the intersection of the slits, as seen from the other side, appears as a continuous ring of light. A slight difference of speed causes this ring of light to move outward or inward, according to which disc is revolving the faster. The more rapidly the ring moves in or out, the greater the difference in speed of the two discs. If the ring is moving out, a new ring starts at the center when one ring reaches the edges, and these rings keep following one another outward. If the difference in speed is the other way, the successive rings move inward.

In Fig. 3 the heavy dotted line represents the ring of light for a particular position of the two discs.

The position of the ring of light indicates the relative position of the two armatures. The discs may be secured to the shafts, so that when the armatures are in the same positions with reference to the pole pieces (i. e.. the machines are in the same phase), the ring of light will be at the inner or outer ends of the slits. The concentric rings in Fig. 3 represent the phase differences corresponding to positions of the ring of light in this case.

For convenience in operation, the arrangement of the apparatus, which has thus far proved satisfactory, has been as follows: On one side of the pair of discs is placed an incandescent lamp enclosed in a box. One side of the box is close to the discs and has a slit in it about half an inch wide, extending from the shaft to the circumference of the disc. This slit is covered with a piece of oiled paper, so as to give a diffused light upon the discs. A complete ring of light is no longer seen from the other side, but only a small portion, corresponding to the width of the half inch slit. A stationary scale is fixed so as to extend from the shaft to the edge of the discs on the opposite side from the lamps, so that the distance of the changing line of light from the center may be read so as to give the phase difference of the two machines by direct reading. To enable one to see the scale and line of light most conveniently, a mirror is arranged at 45 degrees with the discs, so that the line of sight is at right angles to the shaft.

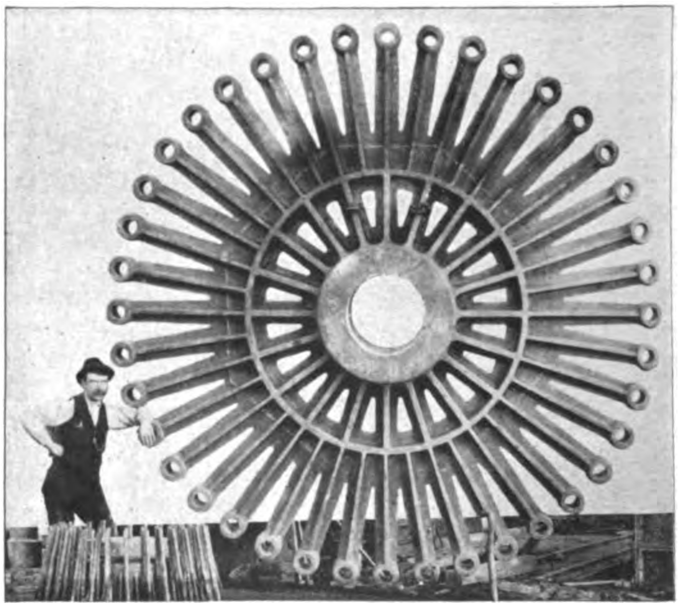
The discs may be arranged in the manner just described upon the abutting ends of the motor and generator shafts only in case the two machines have the same number of poles. Where such is not the case, one or both of the discs can be driven by gears, which will give the proper relative speeds of the two discs.

In operation, the instrument has proved quite satisfactory, giving exact and definite information concerning the changes in the armature lag of the motor. The fluctuations in this lag are usually quite marked, and the conditions which cause them can be readily investigated by this apparatus. For instance, this fluctuation is small with proper field excitation; as the field current of the motor is diminished, this fluctuation increases, the line of light moving rapidly back and forth through a greater and greater distance, which finely becomes so great as the excitation is weakened that it goes a distance beyond which it cannot recover: i. e., the motor gets out of step and stops. It would be possible to make a more detailed investigation of these fluctuations by means of a revolving mirror, and they may be photographed and made of permanent record by means of a moving plate.

The apparatus can be applied to other lines of work involving an investigation of phase differences and synchronism, and may be modified to meet the requirements of the problem in hand; but it is peculiarly suited for use in synchronous motor work, for which it was designed. The scope of the present paper admits only of a general description of the apparatus here given.

A Large Casting for an Electric Generator.

The accompanying cut shows a casting of probably one of the largest armature stars or carriers in the world. It is one of a pair recently made by the Wells & French Company for the Siemens & Halske Electric Company of America. The generator, when completed, is to be placed in a street railway power house at Toronto, Ontario. The armature stars are 13 feet in diameter, and weigh about 10 tons each. The castings came from the mould absolutely perfect, without warps or flaws, which, considering the size and form, speaks well for the makers.



A LARGE CASTING FOR AN ELECTRIC GENERATOR.

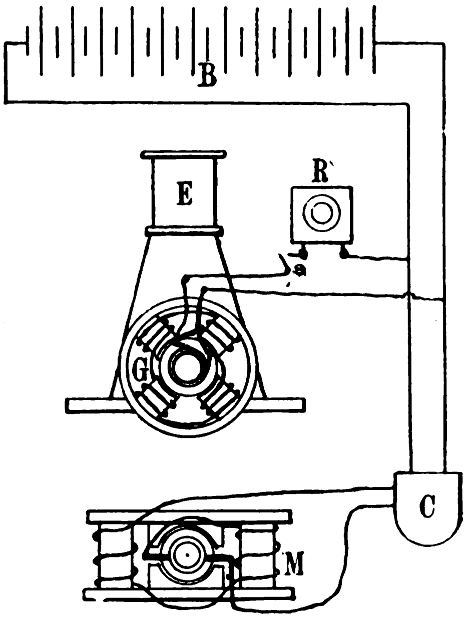
The machine, when completed, will weigh about 60 tons, and have a capacity of 1,200 kilowatts or 1,600 electrical horse power under 500 volts pressure. It will be over compounded for 12 per cent drop in the lines. A pair of direct connected, horizontal, cross-compound condensing engines, making 80 turns per minute, will operate the generator. The brush carriers, which are also being made by the Wells & French Company, will be 14 feet 6 inches in diameter.

Mr. Baker, the engineer who is installing the electric power plant for the new Metropolitan Elevated railway in Chicago, figures that the use of electricity will save that company $300,000 a year in operating expenses, compared with the cost of running trains by anthracite-burning locomotives. The saving in fuel alone by using soft coal in stationary boilers instead of hard coal in locomotives is figured at $200,000, and the difference in salaries if high-priced engineers had to be employed for each train, with other economies which electric power will give, are expected to amount to at least $100,000 a year more.

The Patton System of Street Car Propulsion.

An electric railway with neither an overhead nor underground trolley system and on which each car carries its own power station has been designed by Mr. W. H. Patton. The first car of the kind is in operation on the Sixty-seventh street line of the Calumet Electric Railway, where it has been running some time. A large number of persons have visited it and have ridden over the line to watch its operation. It runs very smoothly and gives every indication of a satisfactory system for street railway, whether for long or short lines. Its inventor has studied every feature of the street railway problem and believes that this system, as now perfected, will fill every requirement of rapid transit lines.

The equipment of the car includes a gas engine, directly connected to electric generator, a storage battery of such a size as the traffic on the line requires, and an electric motor with the necessary controlling apparatus. The gas engine is of the vertical type placed on the truck in the center of the car, the floor being cut away for that purpose. The direct connection of the engine and generator brings them into a small space and necessitates no gears to wear or rattle in operating. The generator is shunt wound and of standard manufacture. The storage battery equipment of this car consists of 110 cells of the Plante type. The motor is of the ordinary type, and its size, as is also the balance of the equipment, is regulated by the traffic of the road and character of the track. The controller is also of standard type adjusted to this equipment.



THE PATTON SYSTEM OF STREET CAR PROPULSION.

The different machines have been arranged so that but little space in the car is occupied, which is one of the great advantages of this system. Something of the relations of the different machines may be had from the accompanying diagram. The gas-engine is shown at E, the generator at G, the battery at B and the motor at M. The rheostat is represented at R, the controller C and a switch S. A shunt wound generator, when used to charge a battery will act as a motor and revolve in the same direction without any change in the connections, if current is passed through the generator. This principle is utilized to start the engine. The generator has a voltage of 250 and the batteries are of 220 volts, from which it will be seen that as soon as the generator is up to speed current is made to pass through the battery where the energy is stored; but if the motor be started only such current as is not used by the motor will pass through the battery. It will thus be seen that the battery is fully charged a greater part of the time. This action takes place while the engine is running, and does not require any changes to be made by the motorman, except the usual manipulation of the controller to regulate the speed of the car.

It is not necessary that the power of the engine should be as great as that required for the heavy grades or sharp curves, for so soon as the demand on the generator is beyond its capacity, the engine slows down, reducing the voltage of the generator. When it reaches 220 volts the battery aids in the work until the load is reduced, and the generator reaches its normal voltage. It will thus be seen that neither the engine nor generator need to have a capacity equal to the maximum load. The economy of the system will also be noticed, the surplus power on the level track being stored until it is needed on the grades.

The motor has been in daily operation on this line for some time past, giving general satisfaction to passengers and the management of the road. On this line there is an eight per cent grade, which the car, pulling a standard-sized trailer, mounts with ease, even when started from the foot of the grade, which shows a large surplus power. Its regular rate of speed is 15 miles per hour, but it can be geared to run at any speed desired, that being merely a subject of equipment. When in operation the motion of the car is as smooth as that of any vehicle and there is no disagreeable noises from the working of the machinery. The motor car seats comfortably 36 persons although it is but 16 feet in length. The power required when pulling trailer is not great, as the engine consumes but 20 gallons of gasoline during the 12-hours' run. The dynamo has a capacity of 65 amperes, and that of the battery permits a current of 40 amperes to be taken from this source.

It is the intention to build these cars as a locomotive, designed to haul as many trailers as may be required, this being the best plan where the traffic will warrant or there is any objection to combination cars. This car weighs 15,000 pounds as against 12,000 pounds for a trolley car of the same capacity, while the operating expense is only about one-half. The car on Sixty-seventh street is running at an expense of about $1.00 per day, exclusive of motorman and conductor. The motor car is the invention of W. H. Patton, of Chicago, who has patented it in the United States and Europe; it is being introduced by the Independent Electric Traction Company, whose office is in the Old Colony Bldg., Chicago.

A party of twenty gentlemen and their ladies accompanied the officers of the Calumet Electric Railway on a tour of inspection one day last month. The road, of which several lines were hurriedly completed to accommodate the World's Fair traffic last year, have this spring been greatly improved, making it a delightful road to ride over. The advantages the road offers to summer visitors and excursion parties besides the facilities it posseses for reaching that growing part of the city, are greatly appreciated. The persons who accepted this invitation of the company expressed themselves as highly pleased with the trip on their return. The train in which the party road was gayly decorated and everything was done that could add to the pleasure of the guests of the road.

The Overhead Trolley System.*

BY O. M. RAU.

The much-abused, though silently welcomed, electric trolley street railroad system has received considerable attention from inventors and street railway managers within the last few years. Through their combined efforts a point of perfection has been attained, where, it is safe to say, no radical improvement will follow, and a system constructed on the standard of today will not be outclassed by future construction. Not only is there little room for the protection of an overhead trolley line, but the minds of the inventors are now taken up by the underground and storage battery systems, and the drift in improvements for electric street railways will be in these directions.

Discussing the subject recently before the Wisconsin Electric Club, the author took the stand that the maximum success which an overhead trolley system can attain has been reached, and capitalists need no longer wait in deciding to use this system, expecting to see it brought to a higher point of perfection.

The improvements from the first overhead line to the present form of construction have been astonishing. Yet to the untrained eye it appears the same eye-sore as the first one put up, and it must be admitted that very little has been done to improve its general appearance. This could be accomplished with little expense, by artistic poles and neat wiring, which would do a great deal towards its approval by the public. The main efforts in improvements have been to make it safe and reliable. The system of three years ago is like a flimsy spider web compared to the heavy structure of today. Instead of a No. 4 or 6 trolley wire a No. 0 is used; instead of poles made of gas pipes, a special drawn steel or lattice pole is used, and instead of making the material as light as possible, it is made strong, without reference to weight.

The system of poles for a trolley road is still much discussed; and between side and center pole construction there is so little preference that it is impossible to adopt any one as a standard. Local conditions must determine which to use. The side pole has in its favor the small cost of maintenance, but the greater first cost has prevented its use on suburban lines, and the opposition of property owners to having poles in front of their houses, as well as the hindrance to the fire department, have proven serious objections to its use in the business portions of cities, and the center pole has been adopted wherever the streets are wide enough to allow poles to be placed between the tracks. The main advantage of the side pole system, as stated before, is the limited cost of repairs, which is mostly due to the flexibility of the system. The span wire suspension forms no rigid construction, and there is a certain amount of slack which will give under the pressure of the trolley wheel, thus avoiding the sudden blow to the trolley clamp, keeping the wheel in more perfect contact with the wire, and reducing the liability of the wheel jumping. The life of a trolley wheel is considerably increased by these advantages, as the tension on the trolley base spring need not be so heavy, and the friction is reduced both on bearing and periphery of wheel. These advantages lead to the adoption of the side pole system where a large number of cars are operated, which would warrant the extra expense of this construction.

The preference of city authorities, as well as by property owners, is for center pole construction in the business portion of cities. A thoroughly constructed center pole system should not be any more expensive to maintain, with the exception of wear on the trolley wheels, than the side pole system, and if the poles are of neat design and well maintained, their presence will not affect the appearance of a street, and certainly will prevent ambitious drivers from occupying the whole roadway. The danger of the poles being close to the cars is very slight, and, up to the present time, no serious accident has been attributed to this cause.

The cars must be provided with gates on the inside platform, whether side or center pole construction is adopted, as the danger from jumping in front of a car running in the opposite direction is equally as great as coming in collision with the poles. By having these gates well secured, any accident from this source is avoided; the danger from bridges, where the truss construction comes very close to the cars, is far more serious than from the center poles.

For first-class construction, as well as embodying neat appearance, the lattice or built-up iron pole has proved most substantial. This pole is very strong, and at the same time, has enough elasticity to prevent its bending from any sudden blow or strain. The poles well set in concrete, about six feet in the ground, will keep a trolley line from getting a staggering appearance, and there is nothing that improves the looks of a pole line more than systematic construction. For side poles, the lattice type is much used, but a heavy tubular form is also convenient. The setting of these poles should be similar to that of center poles, but should have a rake in the opposite direction to the strain, and should be fitted with an insulated pole top.

The span wire is a very important part of this plan of construction, and should be insulated from the ground, and securely fastened with provisions for taking up slack. These requirements are easily met by mounting the pole with a hardwood top, usually of maple, well painted, through which a hole is bored for an eyebolt with a thread, so that by tightening a nut it will draw the eyebolt through the pole top and tighten the span wire, which should be of ¼ inch galvanized steel cable.

The trolley wire bells or insulators, of which there are about as many styles as there are men selling them, form the principal item of expense in the maintenance of an overhead system, and this should receive the most careful study before a specific bell is adopted. Of the numerous forms, some of which are herewith illustrated, the only satisfactory one, from a financial point of view, is the metal-covered form. It should have means of fastening to the span wire or center pole cast on the outside shell. This will do away with additional parts as well as screws or eyebolts. The illustration represents the three stages of improvement in trolley insulator bells. At the left is the molded insulation type, with threads on the upper and lower ends into which the eye bolt or stud is screwed: the middle one is the metal-covered form with a taper stud molded into insulation which wedges between mechanical clamps to hold the wire; the third has a metal shell with detachable insulation, and is the latest improved form.

For span wire work, the standard form, conventionally called a straight line hanger, is the most suitable and quickest to hang. The center pole has given occasion for various patented forms to be placed on the market, such as placing springs between the bell and the pole arm, and other devices to form a flexible connection between the pole and hanger, to do away with the rigid fastenings when simply bolted to the pole; but the numerous forms tried by the author not only proved too expensive, but of very little value in aiding the flexibility of the line.

A fastening very much employed for center poles is the swivel joint, which allows the bell to swing forward or back, as the trolley wire may have occasion to draw it. This has given rise to a large number of trolley wire breaks, as the clamp holding its position at right angles to the bell will draw the trolley wire out of a straight line, and when the bells hang at an angle the end of the clamp is presented to the approaching trolley, which, in a very short time, will have nicked the wire so that it will break. This plan of fastening was made necessary from the large number of clamp studs or screw eyes which would break when the bell was bolted to the pole rigidly. The improvement made in overhead parts has changed this, as the screw eyes and studs are either done away with entirely or increased in size, so that they will stand any reasonable strain. When the bell is fastened as a rigid fixture to the pole and the trolley wire held firmly in it, each pole will receive its own share of the strain from the wire and need only take care of the span between it and the next pole. In this manner the bells will remain at right angles to the trolley wire and the clip or clamp will always remain in a straight line. The clamp or clip is perhaps the most troublesome to decide on, although a selection between a mechanical clamp or a soldered clip is usually in favor of the former. A soldered clip, although giving the neatest appearance as well as the smoothest surface to the trolley wheel, is expensive to put up and interferes considerably in repair work, which unless done with the utmost care, will be a continual source of trouble. In fact, any device which requires soldering is not to be recommended on a trolley system. The average line man is not careful enough with this work, and will invariably overheat his solder, which will soften or anneal the wire more in this spot than elsewhere, resulting, when under strain, in its drawing out at this point, making it thinner and ultimately breaking. This is most noticeable in the soldered sleeve, and over 20 per cent of trolley wire breaks can be traced to the heating of the wires during soldering.

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*From Cassier's Magazine.

A mechanical clamp, to be substantial, should have as few parts as possible, be free from screws or nuts, and hold the wire firmly without interfering with the trolley wheel. There are numerous patented devices to attain these effects, but nine-tenths of them have too many parts, are too weak, or cost too much. A very important feature which has been overlooked in most mechanical clamps is the corrosion of the threads on the studs or screws which form the means of holding the clamp to the wire, and, in numerous cases I have seen, where the clamp had to be cut to pieces in order to get it off the trolley wire. The stud in the bell should be extra heavy, not less than $\frac{5}{8}$ inch, as this very likely to break. For center poles this stuff must be especially strong, as the strain on this part of the hanger is very great, and the number of line patrol calls is greatly governed by their strength. It is, perhaps, interesting to see what a difference this simple little stud makes to the patrol department of an extensive electric railway system. From the record sheets of a line having about eighty miles of road and about 4,000 bells on center poles, a total of 3,700 calls were recorded for the year 1893-4. Of these 3,230 were to replace bells on which either the screw eye on top or the screw stud on the bottom of the bell had broken. These were 7-16 inch in diameter. From this it is apparent that almost every bell on the system was replaced during a period of one year. With proper construction on a center pole system there should not be more than one hundred calls per one thousand bells per year, or a depreciation on the system of about ten per cent, not including value of bells taken down, which can be repaired or used again. The exposed position of the hangers has favored the use of brass for the metal used in the material, but this simply increases the expense, and is of no special benefit, as the strength of malleable iron is far superior to that of the cheap grade of brass generally used, while the corrosion is insignificant on these castings.

The sizes of trolley wire used in the evolution of electric street railways has now arrived at a standard, and it is peculiar to note that the first road operated used the present standard size of wire, which is No. 0 hard drawn copper. The experiment of using silicon bronze of small gauge has proven a very costly line to maintain, besides increasing the wear on the trolley wheels. The wear on a trolley wire on straight lines is imperceptible and a line should last at least ten years without re-wiring, and with good road beds and rigid inspection of trolleys the breaks should not exceed one per mile of double track road per year.

An important, but not much used, plan for trolley wire systems is the auxiliary main distributing system. This auxiliary main of No. 0 insulated copper wire is usually run along the top or side of center poles, and at intervals of 600 feet is connected by means of No. 4 flexible wires, termed sub-feeds, to the trolley wire. The connection is made by a sub-feed clamp. This is the ordinary clamp provided with a lug and set-screw to firmly clasp the sub-feed wire, making a connection through the clamp with the trolley wire. The advantages of an auxiliary main are very numerous. By its means a more equal distribution of power is obtained, the connection at switches and crossings need not be relied upon to carry the current, and the drop on long lines is overcome, which otherwise would have to be wired with a larger size trolley wire. It is especially useful in carrying the current over crossings of other lines or where the trolley has to be insulated through a circuit breaker. The expense of adding this auxiliary to a trolley line is very small and should not be omitted in an extensive system. The distribution of the current to an electric railway has not received the attention that it should, and a great many roads simply take the ends of the trolley and connect them to the station bus bar.

A thought of equalizing the potential is never entertained; yet everyone knows that a motor built for 500 volts cannot operate with efficiency on 350 volts, but this is very commonly the case near the ends of a line, and in many instances this drop can be avoided to some extent without the addition of copper by a proper plan of distribution. In a system covering an extensive area, where feeders to different sections are used, a very interesting study can be made of feeding sections to obtain the best results in accordance with the number of cars and other local conditions. This I have carried out in a very extensive plan on the system of Milwaukee. There are twenty-one feeders to distribute the current over a radius of three miles from the power house and supplying current for forty miles of double track.

The original plan of feeder sections was probably laid out theoretically according to the size of the feeders and the distance they had to feed. By taking potential readings during the operation of the road, I found in some instances a drop of 25 per cent, while the calculated drop should not exceed ten per cent; and on another feeder but two or three per cent where ten per cent was allowable. By changing the sections so as to obtain the largest area of copper, or make a loop circuit for one feeder section, and by arranging the sections according to the profile of the road, this excessive difference of drop was considerably equalized, although there was still some difference in the potential of different sections which could be easily noticed when passing a circuit breaker from one section to the other. The advantage of having the line in sections is very important; a trolley wire breaking or other accident happening to any particular section will delay only that part of the system. Yet the only way to equalize the pressure over the entire system is to have all the feeders connected together as one large web work, similar to an illuminating distributing system where the mains would resemble the trolley wire. To obtain this advantage I placed a fuse box between each section, with a fuse of one-fourth the carrying capacity of the main fuse on the feeder in the station. The fuse was fully capable of carrying all the current necessary to equalize the pressure between the adjoining section and still was so light as to blow if the plug or fuse in the station was out. In this manner a wire down, or other ground, would blow the station fuse first, this supplying most of the current feeding the ground. After this was blown, the light fuse of the section would blow immediately, leaving the grounded section dead. The repairs to the system would be made without greatly delaying the operation of the road. The potential over the entire system is equal and would be perfectly feasible to supply current for lights and motors for commercial use from the trolley wire system.

Another important part of an overhead system is the apparatus for protection from lightning. In plants where an extensive overhead feeder system is in use this is a troublesome enemy, and the safest trap for it is a tank arrester at the station, Fig. 3. This was perfected by A. Wurts, and consists of a soil of heavy wire placed in a metal lined tank filled with water and connected with a perfect ground. The total current generated is passed through the coil before it is distributed through the feeders. Any lightning discharge which follows the wire is obliged to pass through the coil, and, as lightning will be opposed by induction in attempting to follow around the coil, it will prefer to take the path through the water to the ground. This arrester has proved very efficient, and, although a slight loss is continually going on through the water to the ground, this is not objected to, as the tank need not be filled with water except during storms. For trolley line protection a number of lightning arresters have been devised, although but few embody the requirements for an outdoor arrester. To protect a large system against lightning requires about one arrester for every mile of trolley wire, and, considering the distance covered by a trolley system, an inspection at intervals of this apparatus is out of question.

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CORRESPONDENCE, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

ADVERTISING RATES upon application.

CONSIDERABLE attention has been given to the length of rails for steam roads by railroad managers, and the General Manager's Association of Chicago recently appointed a committee of civil engineers to prepare a report on the subject. The report covers the use of 45 and 60 ft. rails, which have been laid on several roads, and says: "The result of the inquiry is to the effect that no serious difficulty has been experienced in transporting and maintaining rails as long as 60 ft., and that the 60 ft. rails are preferable to any other length over 30 ft., on the score of economy." The benefits likely to be derived from the use of 60 ft. rails are given as: 1st. Economy in first cost and maintenance of joints. 2d. Fewer accidents at rail joints. 3d. Smoother riding tracks." On electric railways the same benefits would be received, to which would be added greater economy in the electrical circuit, where the rails are used for the return circuit, due to the lower resistance of the return circuit, one-half as many joints, and one-half as many bonds or welds. The above committee recommend the railroads to lay a section of 60 ft. rails, and watch the effect as compared with standard lengths. Street railway managers might do the same thing, and in that way find out whatever advantages they might have for street railways.

THE restless and unsettled feeling that seems to pervade all classes, due to the conditions of business, has manifested itself in many forms. The panic of last summer, the partial resumption of business during the winter and the quiet spring that is just past has been severe both upon the employer and the employe. The employes, looking toward spring and expecting the resumption of business and their former wages, have been generally disappointed. In the west, where the depreciation of silver closed many silver mines and other industries buoyed by the surplus capital of prosperous times, are now helpless that that support is withdrawn. The unemployed, especially of the roving and parasitic classes, have, under the leadership of some fanatic, sought to reach the eastern states by levying on the inhabitants of the districts through which they passed. In the east, as well as the middle states, the dissatisfaction of the laboring classes is shown more in the recent strikes, which have assumed in many cases serious aspects. These manifestations, which increase rather than alleviate the conditions, appear of much greater importance than they really are. The effect on business for the time being is most depressing, and the expense of restraining the lawless and riotous elements to the counties and states will be felt when taxes are paid for the year, yet business in general has gradually improved. The financial reports show but two-thirds as many failures as for the same time a year ago, the movement of goods increasing and the confidence of traders spreading. The electrical industry, although it has suffered with other industries, is steadily improving and a much better feeling pervades the trade.

ELECTRICITY, on account of the facility with which it is transmitted, has increased greatly the use of machinery in many industries. Machinery, with the exception of the drill operated by compressed air, has been previously little used in mining. The limited space, the irregularity of the veins, the character of the seams, the prejudice of the miners and the distance of the "face" from the shaft are some of the difficulties to be encountered in the introduction of machinery. In some coal mines where the conditions are favorable, coal cutting machinery is being used to advantage. The number of inventions of this nature upon which patents have been granted is constantly increasing. A majority of these devices are designed to be operated by the electric motor. In England very satisfactory trials of electrical coal cutting machines have been made. At the Lidgett colliery near Barnsley, Messrs. Robert and Thomas Clarke have introduced these electric coal cutting machines and the results have been sufficiently good to warrant the construction of electric power plant and the adoption of the Clark machines. On the trial the machine cut ten yards 40 inches deep in 12 minutes. It is probable that at no distant day the mining of coal will be carried on in an entirely different manner from the present. The electric haulage systems that have been installed in the United States have shown its advantage over the mine mule and as the value of electricity for power transmission is better understood its use will be extended.

THE establishment of municipal lighting plants involves many important questions, not only those common to every public industry but many that are particular to this. That the city government should carry on certain branches of business few deny, but the extent to which it should enter the domain of the employer and manufacturer is the point where the differences arise. The legislative and executive functions are those for which it was created. The fire department is looked upon as belonging especially to the municipality and for hygienic reasons as well as a fire protection, the waterworks have, with few exceptions, been established by city governments. At this point, however, opinions seem to diverge. While some advocate the operation by the city of all street railway, telephone and all business of like character, others believe that the limit has been reached that the city should go in that direction. The number who uphold the establishment of public industries have been of a sufficient number so that municipal lighting plants are quite numerous in the United States. These plants have been established under peculiar circumstances. The belief that the city could furnish street lighting cheaper than it could purchase it from a private company, aided by the agent, who is anxions to sell the equipment, has placed an elephant in the arms of many cities. It cannot be denied that there are many municipal plants, several of which have been illustrated and described in ELECTRICAL INDUSTRIES, that are successfully operated, both as regards economy and efficiency of the service; and there are municipal plants whose operation costs the city up to nearly 50 per cent more than the same service could be purchased from the local company. The establishment of plants in the smaller cities in connection with the waterworks or other departments of the city has favored their economical operation. Without question, in many cases municipal plants are not paying investments when all things are considered, especially those that have been established some time. In establishing these plants the rights of local companies have not always been respected. The older lightning companies, to whom is due in a considerable measure the present perfection of the lighting system, spent on their earlier apparatus large sums of money in building up the commercial lighting business. In several cases this service has been overlooked and in the establishment of municipal plants the capital invested, which derived a no small part of its revenue from the city, has been ignored. The expensive lines and systems of distribution have, upon the establishment of the municipal plant, become valueless in that service and the expense necessary to change them to serve other customers almost equal the construction of new lines. Contracts have been broken by city authorities, throwing, without redress, upon the company, the expense of that part of its plant and its preparation for a continued service. In contemplating the establishment of a city plant the authorities cannot examine too closely the rights of the central station. What seems a public benefit is often quite the contrary. Every business corporation aids in the life and welfare of the city and the destruction of one not only brings ruin to its stockholders but affects the welfare of the community.

The Metropolitan Electric railway will be the first all elevated electric railroad to be permanently built in the United States. The adoption of electricity on this road was undoubtedly influenced by the successful operation of the Intramural railway at the Columbian Exposition. The engineers of the road have made careful estimates of the cost of operating the road by the different methods. These estimates showed electricity to be by far the cheapest. The road is already constructed over the largest part of its course, and the foundation for the draw-bridge across the river is nearly completed. The line will be constructed toward the center of the city as far as Franklin street, where it will await the solution of the question that all the elevated roads are trying to answer, how to build so as to best accommodate the business district. The contract for the electrical equipment has been one of the most important contracts let recently. It covers both the electrical construction work and the necessary apparatus. Bids were received for both the entire equipment and for parts of same. The power station will have four generators, two of 1,500 kilowatts and two of 800. The motor cars will be equipped with two 100-horse power moters, one mounted on each truck. The method of transmitting the current will be similar to that on the Intramural, by means of a third rail and a 500-volt current will be used. It is expected that trains will be running early in the fall, although the work yet to be done is considerable. Among the companies who placed bids for the work were the General Electric Company, which has been awarded the contract, the Siemens & Halske Electric Company of America, the Westinghouse Electric & Manufacturing Company and the Walker Manufacturing Company of Cleveland. The equipment to be furnished by the General Electric Company will be of the standard type manufactured. It will be quite similar to that used at the World's Fair, different only in details, where improvements will be made. The site for the power house has not yet been determined upon. The company owns the Throop street lighting plant, which formerly belonged to the lighting department of the city of Chicago. The completion of this road, and the results of a year's operation, will show to other elevated railway companies the benefits of this method of operation.

It is reported that races will be held at night at the Brighton Beach race course by the aid of the electric light. Arc lights are to be placed around the course, the grand stand and all parts of the ground, making it almost as light as day.

The largest Schukert search-light, which attracted much attention at the World's Fair, has been placed on a 100-foot tower at Sandy Hook by Mr. F. Tischendorfer, who was in charge of the exhibits of Schukert & Co. at the Exposition. The light will be used by the navy department to test its value in coast defense.

Good eyesight has always been one of the necessary qualifications of the locomotive engineer, but on the slower moving street railway systems of our cities this has received little attention until recently. On several electric lines motor men are now examined by physicians and their eyesight tested, and unless the examination is satisfactory positions are not given them.

The worst street railway accident for the month occurred on June 18th, at Patterson, N. J. A trolley car was crossing the tracks of the New York, Susquehanna & Western Railroad, and when in the center of the track it was struck and ground to pieces by the Deckertown express. The escape from instant death of the twelve occupants was miraculous. Eight were seriously injured, and four but slightly. The gateman is reported as responsible for the accident, not being at his post.

An improvement has been made recently in the electric log which was invented by Fleuriais in 1878. In the original a telephone was used, but in the later device an electric bell is used. The bell is struck every 24 revolutions of the mill-wheel, and by timing the strokes the speed of the vessel is determined. In the old method the making and breaking of the contacts by the revolution of the wheel sounded the telephone, but in high speeds it was impossible to distinguish the note.

One of our foreign contemporaries calls attention to an amusing piece of electrical fiction, which is somewhat as follows: An ingenious inventor devises a method of electrically extracting the bones from bloaters. The apparatus includes a small electric battery and a pair of jaws for contacts. The head of the bloater is cut off; the jaws grip the end of the back-bone; an electric shock is sent through the fish, which separates the bones, and a gentle pull on the tail of the fish removes the flesh, leaving the skeleton of the fish in the jaws of the electrical machine.

Last March the Mutual Electric Light and Fuel Company was granted a franchise to establish and operate an electric lightning system in the district south of Thirty-Ninth street and west of State street, Chicago. A short time ago the company secured a permit from the commissioner of public works to erect its lines. It was soon after discovered that the current for lighting this district was to be furnished by the Hyde Park Electric Light Company which was contrary to the city ordinances; this, together with the opposition of the telephone company, caused the permit to be revoked. It now looks as if the Mutual company would have to let a contract for a central station or give up its business in this district.

New Quarters of the Great Western Manufacturing Company.

Although the electrical industry in its many branches experienced along with other lines of business the effects of the financial depression of last year, yet its recovery has been rapid, indicating elasticity and strength. The Great Western Manufacturing Company, of Chicago, which ranks among the prominent manufacturers and distributors of electrical apparatus and supplies, has not only had a steady business but found itself this spring obliged to seek larger quarters for its offices and salesrooms to accommodate its business. The new quarters on Market St., near Madison, are especially adapted to the needs of the company. They are well located, commodious and possess excellent facilities for the transaction of business.

The advantages of the new quarters, together with the facilities of the company possesses at its factories, now gives the company a better position than ever for supplying the wants of the electrical trade. The factories at which are manufactured a large part of the electrical apparatus handled by the company enables it to meet in every way the demands of customers. Being in constant communication with the users of electrical machines the company is fully cognizant of their operation and any improvements or devices necessary. Special orders and requirements are quickly filled. In ELECTRICAL INDUSTRIES, Volume IV, Number 4, appeared a description of the company's factories at Duluth, Minn.

The main floor at 116-120 Market St. contains the offices and salesrooms of the company. Near the main entrance are located the private offices, sales offices of both the city and "out of town" salesmen. The correspondence, mailing and book-keeping departments are close at hand. All are arranged most conveniently for the work of the different departments. On this floor is also the fixture room, where are displayed the many styles of electric, gas and combination fixtures manufactured by the company. A very extensive line of fixture glassware is shown, which is especially neat and attractive. For the accommodation of the local trade a line of supplies are kept on this floor under the direction of the city department. The apparatus and appliances include everything electrical in practical use. On the main floor is shown a line of the Great Western dynamos for arc, incandescent and power service, of the different sizes manufactured. The new machines that have more recently been placed on the market are especially noticeable in this group, some of which have been illustrated in recent issues of this journal. The equipment of many stations has been furnished throughout by the company, which is able on account of the wide range of goods manufactured, to take from stock everything required. The large salesrooms enable all kinds of apparatus to be displayed and customers who visit the city have a variety of apparatus to select from.

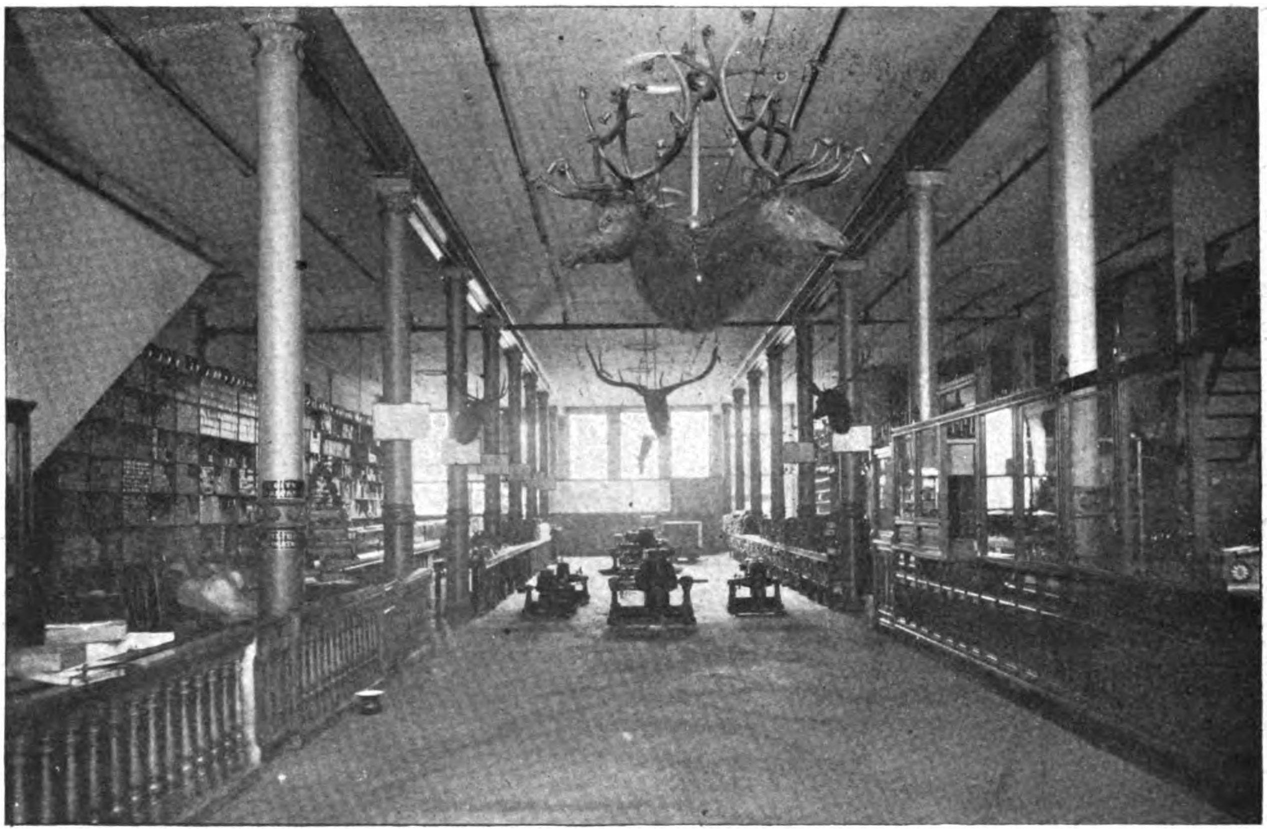


FIG. 1.—NEW QUARTERS OF THE GREAT WESTERN MANUFACTURING COMPANY.

Electrical specialties, wires, cables, house goods and supplies are also found on the main floor. The basement of the building which is almost on a level with the alley where the goods are received and delivered, forms a most convenient packing and shipping room. The basement is also largely used for the storage of the heavier goods and every corner is piled full of supplies and apparatus. A portion of the space is also taken up by the fixture department, which is supplied with power. For more convenient and safer shipping many of the electrical fixtures are shipped "knocked down" and for assembling or changing for customers the department has special facilities.

The warerooms and storerooms of the company show extensive stocks of the various lines of goods, carefully arranged so as to facilitate the filling of orders. A large stock of Clark wire is always carried, fan motors of several sizes are conveniently placed where the demands of the summer season can reach them; wiring and construction supplies comprise a large stock and testing sets and station instruments receive special attention. Central station and power supplies also form an important branch of the trade.

The factories of the Great Western Mfg. Co., are under the superintendence of Mr. Foree Bain, who has been for many years connected with the manufacture of electrical apparatus. Previous to his connection with this company he manufactured electrical apparatus and founded the Bain Electric Manufacturing Company, that was consolidated with the other companies which formed the present company. He has extended greatly the line of electrical machines and placed many new ones on the market. These machines have been characterized by neatness of outlines, good mechanical construction and high efficiency. The facilities for the production of apparatus are of the best that modern practice allows; advantages for procuring the raw material, excellent equipment of tools for its manufacture and skilled engineers and mechanics.

The company has in its management experienced men and on its board of directors appears the names of many prominent business men of the west. Mr. L. R. Casey, the president and treasurer of the company, is well known as a business man and banker. The first vice-president is Mr. R. S. Munger, of Duluth, Minn.; second vice-president, Stephen J. Young, of Brunswick, Me.; third vice-president and assistant treasurer, O. H. Simonds, of Duluth. The general manager of the company is Mr. E. R. Gilman, who has long been well acquainted among the electrical fraternity, especially in the west. Mr. H. K. Gilman is the business manager, who has had an extended experience in the electrical trade and is well known. The light and power department is under the management of Mr. Ernest Cook, who by both experience and natural ability is well qualified for this position. The many equipments of central and isolated stations furnished by the company speaks well for this department.

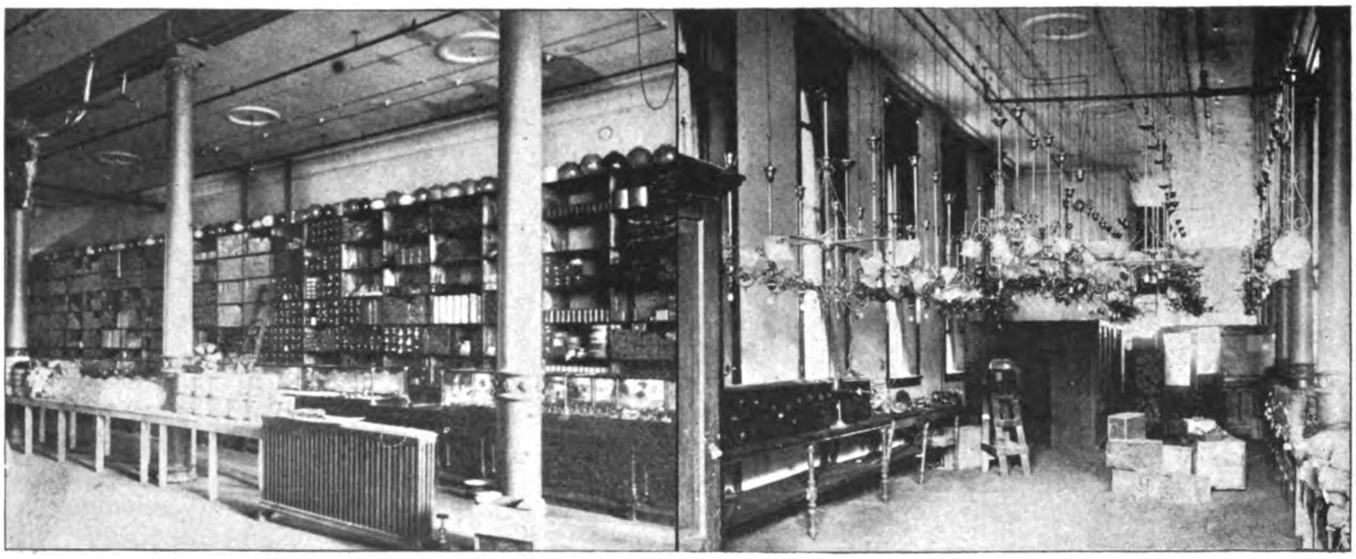


FIG. 2.—NEW QUARTERS OF THE GREAT WESTERN MANUFACTURING COMPANY.

The New Vestibuled Train Service via Chicago & Grand Trunk, Grand Trunk and Lehigh Valley Railways, between Chicago and New York & Philadelphia, via the famous St. Clair Tunnel, Niagara Falls, and the beautiful Susquehanna, Wyoming and Lehigh Valleys, known as the "Switzerland of America," offers elegant appointments and is the most picturesque route connecting these leading cities. Train leaves Dearborn Station, Chicago, daily 3:10 P. M.

Improvements in Wiring.

No part of electric lighting and power work shows greater advancement than the installation of the systems of distribution in buildings. Formerly if the wires were fastened to the walls or ceiling of whatever material with wooden cleats it was considered sufficient. That opinions in this matter have greatly changed a comparison of an old and a recent installation will clearly show. Wood unprepared is not now considered a sufficient installation as its tendency to absorb moisture destroys the insulating qualities which it possesses when dry. Therefore in buildings of mill or frame construction a better insulation than wood is demanded. This is but one of the many improvements that have been made.

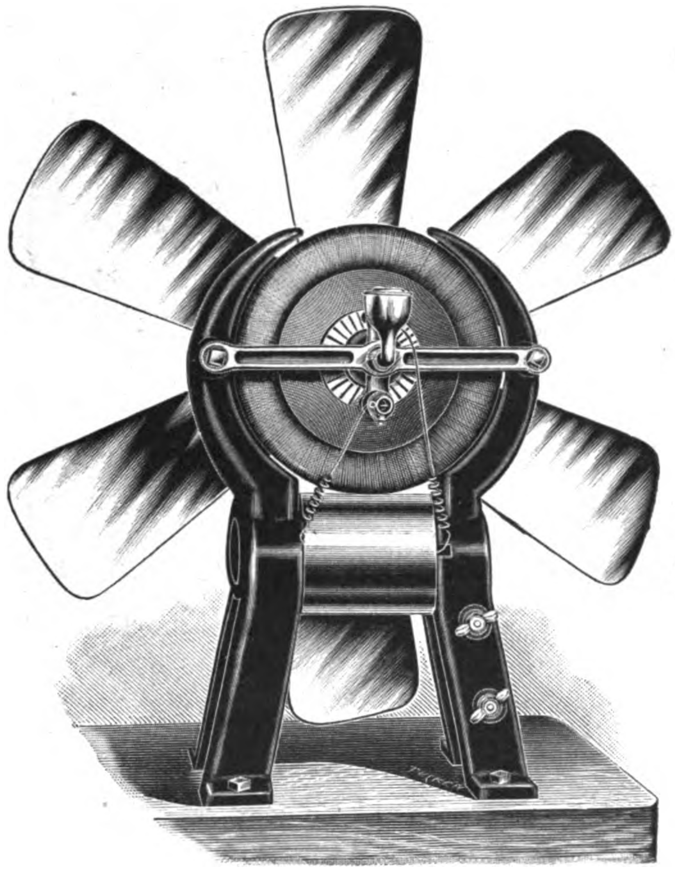
It would have been impossible to have made these improvements were it not that the manufacturers took hold of the matter and devised the necessary appliances. A visit to the salesrooms of the Central Electric Company, Chicago, will show most perfectly the modern methods of wiring and the flexibility and capability of the new systems. In fitting up its new quarters the system of distribution of electricity for light and power was so placed that every part of it is in view showing how every part is arranged. It shows in an excellent manner the interior conduit system of wiring. From this installation Lundell ceiling fans are operated, Helios arc lamps as well as electroliers and numerous incandescent drop lights. It makes a handsome display and a most efficient system of wiring. In fireproof buildings where without some such method the wires would lie in the plaster and against the tile, it has been an economical system because it permits every foot of wire in the building to be examined without removing any plaster, while with the old method grounded circuits were frequent and hard to find. It is always a neat and substantial appearing system, every part being connected by close fittings giving it an air of good workmanship and durability.

The Central company also has a line of bushings for frame construction through which the electrical conductors are passed, protecting them from all poor insulating bodies. These are extensively used being of such a form that they are quickly put in and hold their place. To enumerate the extensive line of goods that this company handles which are used in the modern installation of electrical systems of distribution, would consume too much space for this shor note. A personal visit to their salesrooms would, however, show to better advantage the excellence of modern electrical appliances and devices.

New Haven Fan Motors.

In the electric fan shown in the accompanying cut a new feature has been introduced which changes the character of the breeze which it produces. It is equipped with a 24-inch fan, and when run at one-quarter or one-half speed creates a breeze which is not so sharp as that created by the buzzer, but much pleasanter. It diffuses the current of air more widely about the room, and for large offices and similar places, where papers are likely to be disturbed by the direct breeze of the small, high-speed fan, it is especially adapted.

The motor is strongly made and very efficient, requiring but half an ampere on 110 volt circuits when run at ordinary speed. At higher speeds it requires up to one and one half amperes. It makes no noise; needs but little attention. Oil cups of large size are provided that will contain sufficient oil for a long time. The commutator is of tempered copper and the brushes are self-feeding carbon pencils. The motors are finished in japan and nickel, and are neat appearing pieces of apparatus. These fan motors have been placed on the market by the Wallace Electric Company, of 307 Dearborn St., Chicago. The company carries a complete line of fan motors to meet the wants of any customer. Small as well as large sizes are kept in stock to meet promptly all calls.



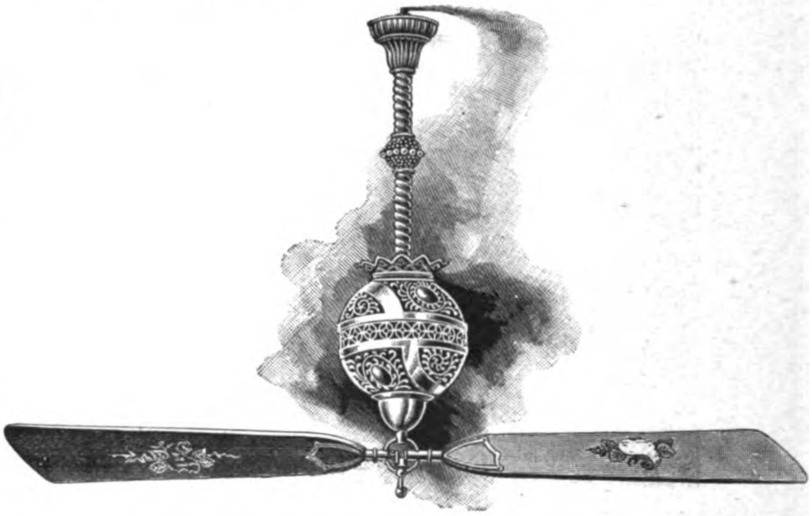
NEW HAVEN FAN MOTORS.

Coney Island is to have an electric scenic theater similar to the one at the World's Fair in the exhibit of the Western Electric Co. A company has been formed to carry out the plan. The seating capacity of the theatre will be about 400 persons, and it is expected that it will be a very popular attraction.

Electric Ceiling and Column Fans.

The accompanying cut illustrates one of the many styles of fans that the Chicago Water Motor & Fan Company, of 101 Lake street, Chicago, has placed on the market. Although the company furnishes fans operated by any kind of power desired it has a line of electric fans that is most complete in every respect. The experience of the company in the design and manufacture of fans and accompanying apparatus gives it the great advantage of facilities and skill for the production of anything in that line. The requirements of a fan for any place for which it is used are well understood and have been met as far as mechanical ingenuity is able.

In the fans operated by a single motor the motor is concealed within the artistically designed casing. Larger motors are furnished for operating a large number of fans when desired. The motors are of a simple and efficient design, substantially made and of sufficient power to operate at high speed the broad-bladed fans. The company is said to manufacture the longest blades of any fans on the market. The fans run noiselessly. The motor is easily started or stopped and does not get out of order.



ELECTRIC CEILING AND COLUMN FANS.

The designs of fans are neat and of various patterns to please different customers. The fans are also finished in different ways and are handsome ornaments in any place. The column fans have a neat, trim appearance and are well suited for many places where floor space can be spared. The motors are wound for 110 volts, but 220 and 500 volt motor are furnished to order. The company carries, to meet the requirements of different installations, couplings, shafting, belts and attachments. A large number of these fans have been put up this season and perfect satisfaction has been given.

In a recent lecture before the Académie des Sciences, M. D'Arsonval, in speaking of the effects of the electric current on the human body, called attention to the fact that the physiological effects of high tension currents passing through the body were very similar to those of drowning, the result being the suspension of respiration which can often be restored by the same means as in case of drowning. A case was cited in which a current at 4,500 volts passed through a man's body. Artificial respiration was attempted and the man recovered. He considers that in the case of American criminals executed by electricity, death ensues in reality from the absence of any attempt at restorative measures, rather than from the passage of a current which is itself destructive to life.

How Root Boilers are Cleaned.

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Every steam user knows that if he is to derive the full benefit from every pound of coal placed in the furnace of his boiler he must keep his boiler clean. He not only derives an immediate benefit, but he prolongs the life of the boiler. The feed-water, if imperfectly purified, produces scale and sediment within the tubes, and the ashes, soot, etc., collect on the outer surface, preventing the penetration of the heat. In the design of every boiler these facts should be considered and provision made for cleaning it. If it can be quickly and easily done it will be much oftener attended to than otherwise.

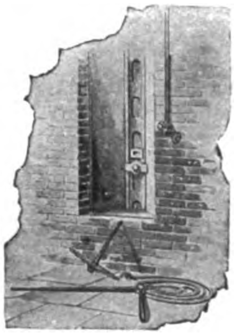


FIG. 1.

In connection with the soot and ashes deposited on the tubes, the vapors and gasses from the fuel are absorbed by their forming compounds that quickly corrode the tubes. The result is that new tubes are required, which not only involves considerable expense, but deprives the owner of their use. In the improved Root boiler, manufactured by the Abendroth & Root Mfg. Company, of New York, ample provision has been made for cleaning both the interior and exterior of the tubes. The tubes are so placed that little foul matter can accumulate and this is easily removed. Each section of the boiler has one or more cleaning slides and as will be seen from the accompanying cuts, there is an opening directly opposite each horizontal space between the tubes. These openings are shown closed in Fig. 1 and open in Fig. 2. By using a steam jet or nozzle in the manner shown in Fig. 3 the ashes and whatever matter may have collected on the tubes is forced off and falls below where it is easily taken out. The direction of the jet can be changed so as to cover the entire outside surface of the tubes. This method of cleaning has been perfected so that it requires but a very short time to the work.

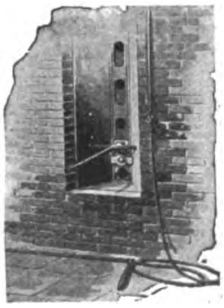


FIG. 2.

The side doors at the bottom of the boiler walls, through which the soot and ashes are removed, are of sufficient size to enable the necessary tubes to be inserted. The slides, through which the steam jet is placed, are as small as will permit the free use of the jet. Thus whether the boiler is in use or not when being cleaned a very small amount of air is admitted to cool the boiler. The hinged doors making a large opening as sometimes used have admitted cold air which, by coming in contact with the heated tubes, have either weakened or fractured them by the unequal contraction of the metal. The small opening accurately placed as in the Root boiler prevents any such occurences. Comparative tests of the Root boilers using the same quality of fuel and under the same conditions, with the exception that one had been in continuous use night and day for weeks without being cleaned, and the other but one day showed that the clean boiler evaporated .23 pounds of water more per pound of coal than the other. The feed water and coal were accurately weighed and all pipes and connections were broken so as to detect any leaks or waste. The observations were made during ordinary running hours.

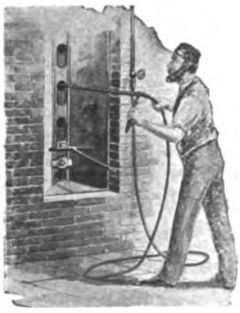


FIG. 3.

Often where boilers are placed in banks it is impossible to use the slides at the sides of the boilers. For boilers so situated a very ingenious method has been devised which is illustrated in Fig. 5. The steam hose is attached to the top end of the vertical pipes shown which are pocketed in the interior of the side walls of the boiler. The lower ends of the pipes are so placed that they revolve easily. Steam jets are placed in these pipes so that they are opposite the horizontal openings between the tubes. When steam is admitted the operator revolves the pipe and the jets of steam sweep the rows of tubes. This method has proved very effectual. An air-tight door beneath the grates in the bridge wall gives access to the interior for removing the accumulated refuse.

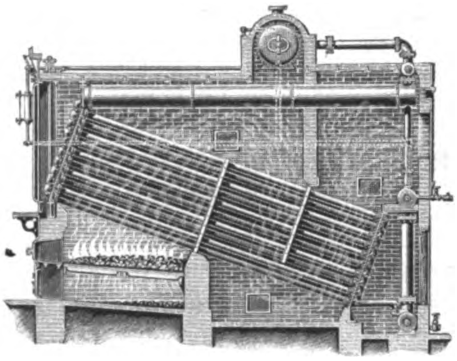


FIG. 4.

A brief description of the Root boiler may be of interest in this connection. In Fig. 4 the general design of the boiler is shown. It is composed of a regular arrangement of four-inch wrought iron, lap-welded boiler tubes, grouped in such a manner that each tube stands immediately over a space between the two tubes beneath it, or, in other words, they are arranged vertically in a staggered position. The heating surface and capacity of the boiler may be increased to any desired amount by increasing the number of the tubes, by adding at the sides or top, or the length of the tubes many be increased. These tubes are inclined at an angle a little less than 20 degrees and enter at each end headers. These headers have a vertical channel through which the water has a clear passage from the bottom to the top. When the boiler is working the water fills the tubes and also about half of the overhead drums. As the water is heated it rises in all the inclined tubes and enters the headers and up to the steam and water drums. In the rear of the boiler will be noticed a drum common to all the drums and connected with each by vertical pipes. The water that has parted with its bubbles of steam circulates down through these pipes into this common drum and from it into the mud drum, after mixing with the feed water that enters at this point. The mud drum is at the lowest point in the system of circulation and receives the sediment and impurities of the feed water.

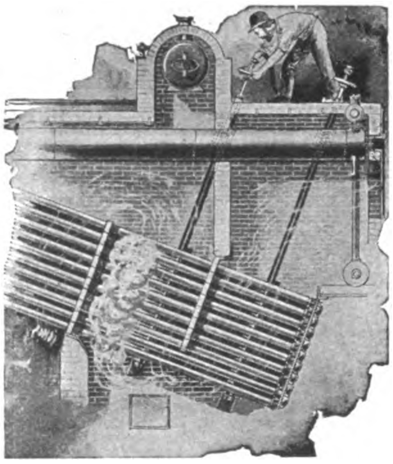


FIG. 5.

The furnace is located under the front end of the boiler tubes through which the gasses pass over the baffle wall through the center part of the tubes and under the second baffle wall to the flue. This is the course in the "three pass boiler" and is not always followed, as different kinds of fuel and other conditions are met to better advantage by special arrangements. This, however, gives the course usually pursued. The details of construction have been very carefully worked out so as to give most efficient and perfect service. The different parts are carefully made and durability is one of the first objects sought. The question of expansion and contraction, due to the changes of temperature while in use and out of use, has been fully met. For the speedy repair of any part most excellent facilities are provided.

Stanley Electric Company's New Two-Phase Alternating Apparatus.

In a majority of the larger towns and cities it is undoubtedly true that central stations find more profit in furnishing current for power than for illumination. While the maximum lighting service averages but a few hours per day, the power service runs steadily eight or ten hours. An engineer in designing a station will, therefore, if he is wise, provide for both kinds of service. The alternating current possesses many advantages for the transmission of electricity, but until recently satisfactory alternating motors have not been on the market. The advantages of the alternating current for stations located at a distance from the center of distribution will always give it the preference where large areas are to be covered from one station.

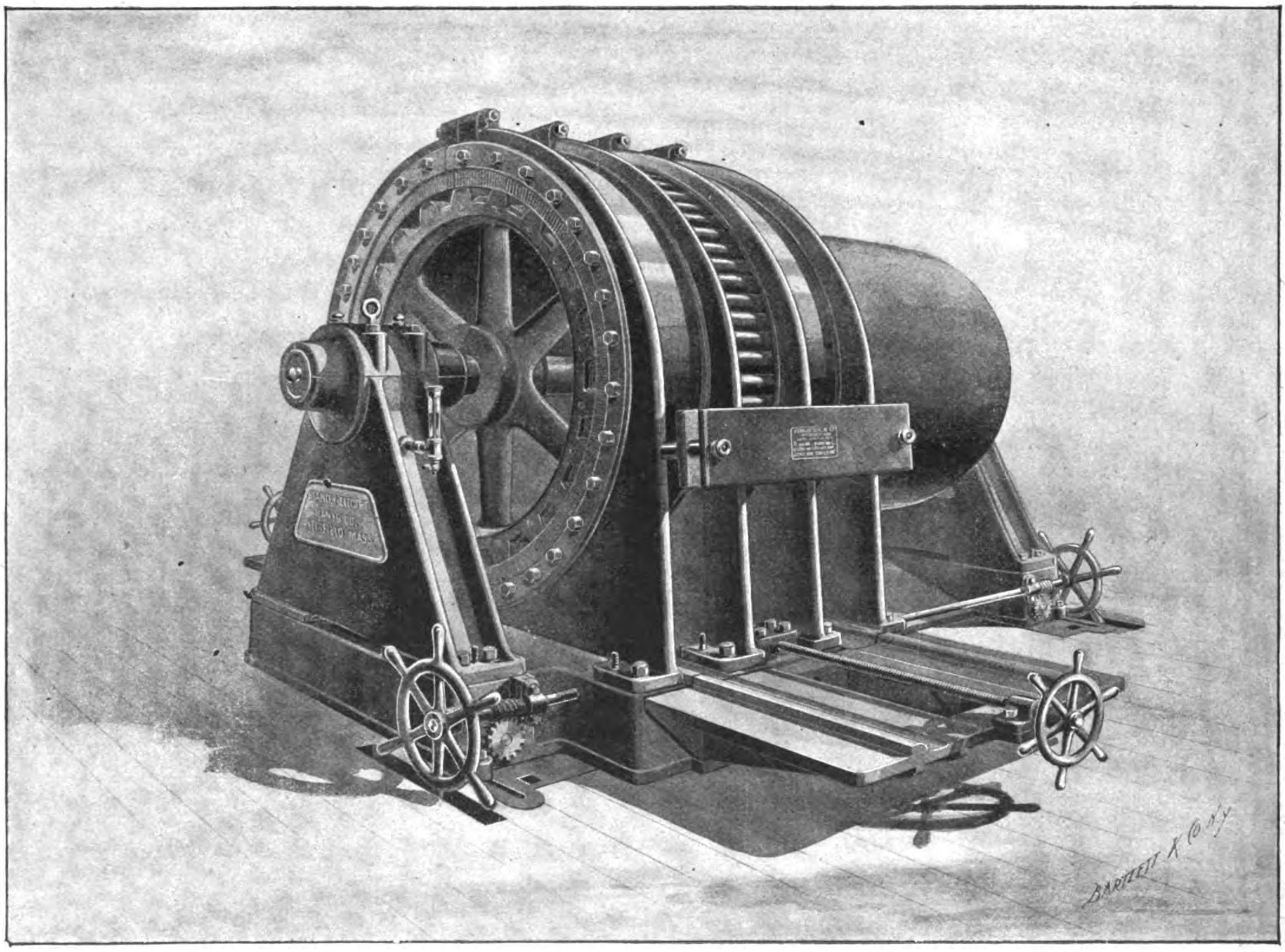

BARTLETT & Co. N.Y.

FIG. 1.—STANLEY ELECTRIC COMPANY'S NEW TWO-PHASE ALTERNATING APPARATUS.

The Stanley Electric Company of Pittsfield, Mass., has just placed before the public a line of electric apparatus which permits central stations to furnish alternating current for both lighting and power. It has been designed by Mr. Wm. Stanley, Mr. J. S. Kelly and Mr. C. C. Chisney, whose work has been united in the production of this system. This apparatus is designated the S. K. C. for its inventors. These gentlemen have for several years been seeking to perfect apparatus with which could be produced a system that would permit of economical and satisfactory service of light and power from the same alternating current generator and circuit, and at the same time a system of such a character that existing lighting companies could operate it in connection with their present apparatus without necessitating the discarding or changing of generators, transformers, etc.; that would also produce a system which would make it possible for those just starting in the business to equip a station with one class of apparatus for all purposes, so as to avoid multiplicity of apparatus and circuits necessary in the past, where it has been desirable to furnish incandescent lights, arc lights and power; and, thirdly, to make possible the commercial transmission of water powers over long distances and the distribution of them for lighting and power purposes by a simple system not requiring the many conversions and consequent wastefulness and the duplication of apparatus made necessary by present methods.

Thus was outlined the character of the systems required, and the apparatus that the company is now manufacturing shows how well the work has been accomplished. The one great disadvantage of the alternating current system of distribution for lighting purposes has been the fact that power service could not be furnished by it, and it is this fact which has made it possible for the direct current systems to keep a grasp on the field. Many lighting companies using alternating currents have, in order to supply the demand for power, been forced to use 500-volt direct current generators, thus complicating their equipment and necessitating extra circuits.

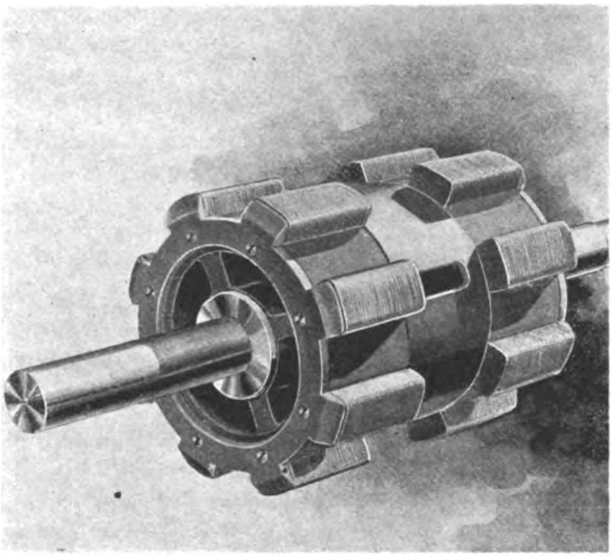


FIG. 2.—STANLEY ELECTRIC COMPANY'S NEW TWO-PHASE ALTERNATING APPARATUS.

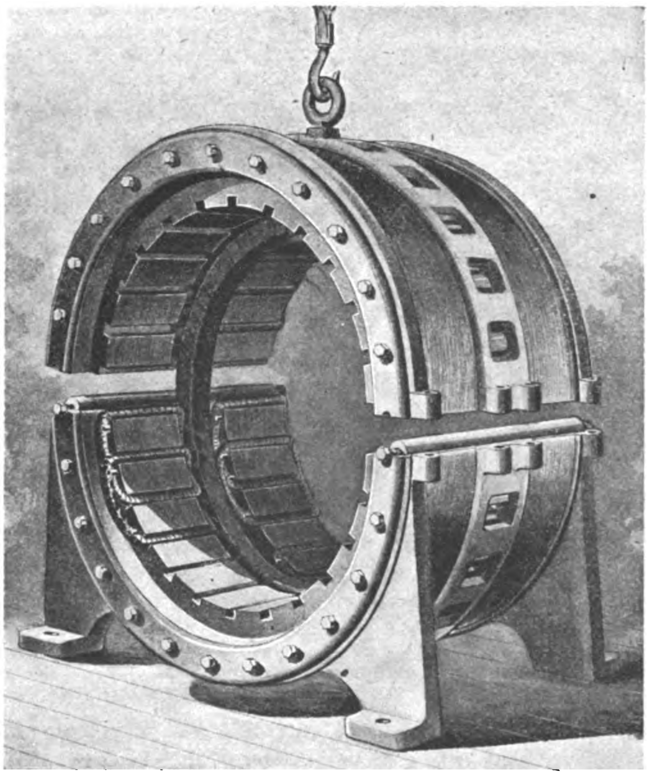


FIG. 3.—STANLEY ELECTRIC COMPANY'S NEW TWO-PHASE ALTERNATING APPARATUS.

The two-phase generators offered by this company are as simple and as good for lighting purposes as the single phase. They can be used interchangeably with present single phase machines, and the two-phase motors are adapted for use on currents of the same frequency as the existing lighting circuits, 15,000 or 16,000 alternations. By adding two-phase generators to existing plant and combining two circuits in an easy manner, or running one or two more line wires, the existing circuits can be used in the daytime for furnishing power, and when lights are required the two-phase machine may be run on one or two of the lighting circuits. The present transformers and generators are just as useful in the plant, and a satisfactory power service is given by the addition of the two-phase generators, which also increase the lighting capacity of the station.

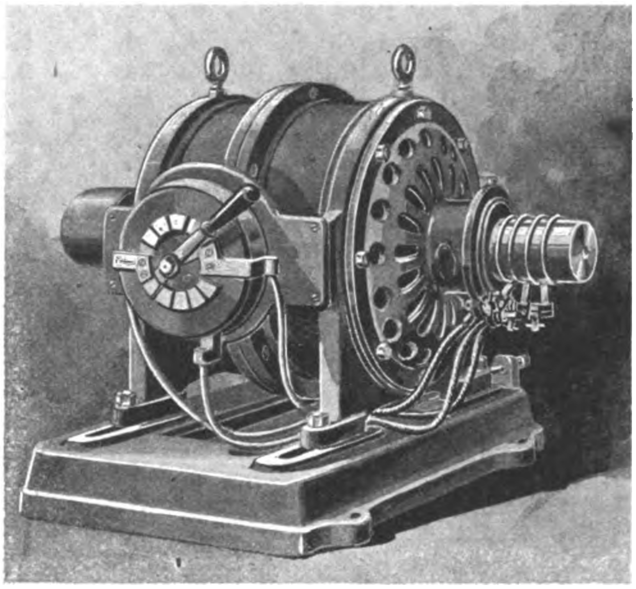


FIG. 4.—STANLEY ELECTRIC COMPANY'S NEW TWO-PHASE ALTERNATING APPARATUS.

While there are strong arguments in favor of the three-phase system where there is a large amount of power to be transmitted over long distances, yet for the ordinary conditions the two-phase system seems to be the best. A number of methods are suggested of changing the number of phases at will to meet these special conditions. Although there are many advocates of low frequency, and there are

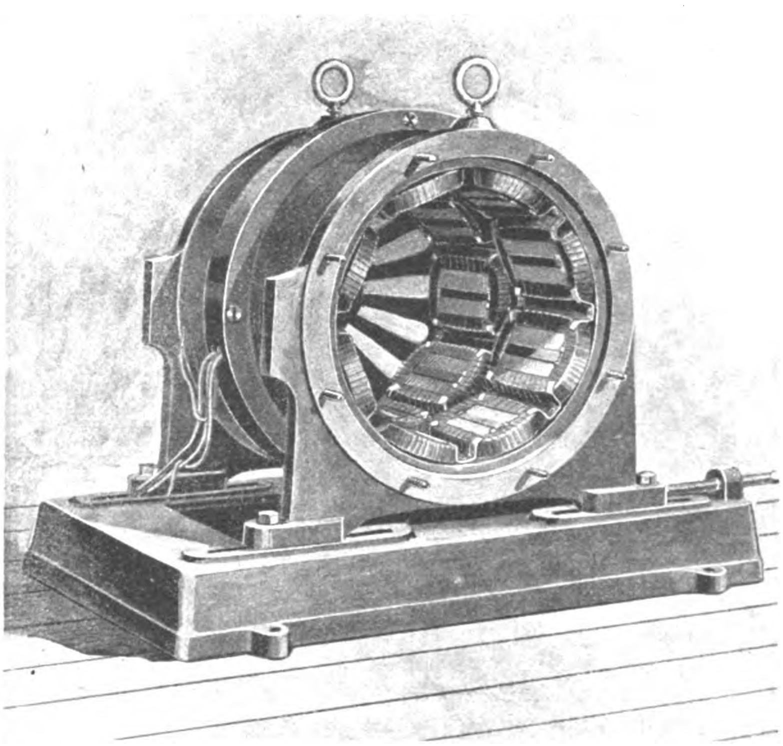


FIG. 5.—STANLEY ELECTRIC COMPANY'S NEW TWO PHASE ALTERNATING APPARATUS.

reasons for using a lower frequency than the standard used in this country, yet apparatus of a lower frequency cannot be grafted onto existing plants in which there are millions of dollars invested. In the study of this question the company has decided to build its standard generators of either 16,000 or 8,000 alternations and motors for either frequency. The company is able to build machines of the same speed for either frequency and for special conditions such as may be required.

The generator which is shown in Fig. 1 represents the design of the 240-kilowatt generator and larger sizes. The design of the smaller generators is slightly modified. Among the noticeable features of this machine is its simplicity, the absence of all revolving wires, no collectors or commutators, strong, good proportions and low speed. The revolving part of the machine is really the field, but is more properly termed the inductor. It is made of a steel casting, upon the periphery of which polar projections of iron laminæ are securely fastened. There is nothing about it liable to burn out, break or wear out. It is as substantial as any piece of iron and has but to be put in place and revolved to do its work. The armature in this machine is quite different from the piece of apparatus that usually is given that name. It here constitutes the body of the machine and is made up of laminæ of iron holding coils of wire. The coils are very small and are wound separately on forms and then secured in grooves provided for them in the laminations. It is an easy matter to insulate them to withstand the pressure of the current. Should a coil be destroyed by lightning or other cause, it is a simple matter to replace it, and does not require skilled labor. To meet any such emergencies a few extra coils are always furnished with the machine. They are not expensive and no special tools are required.

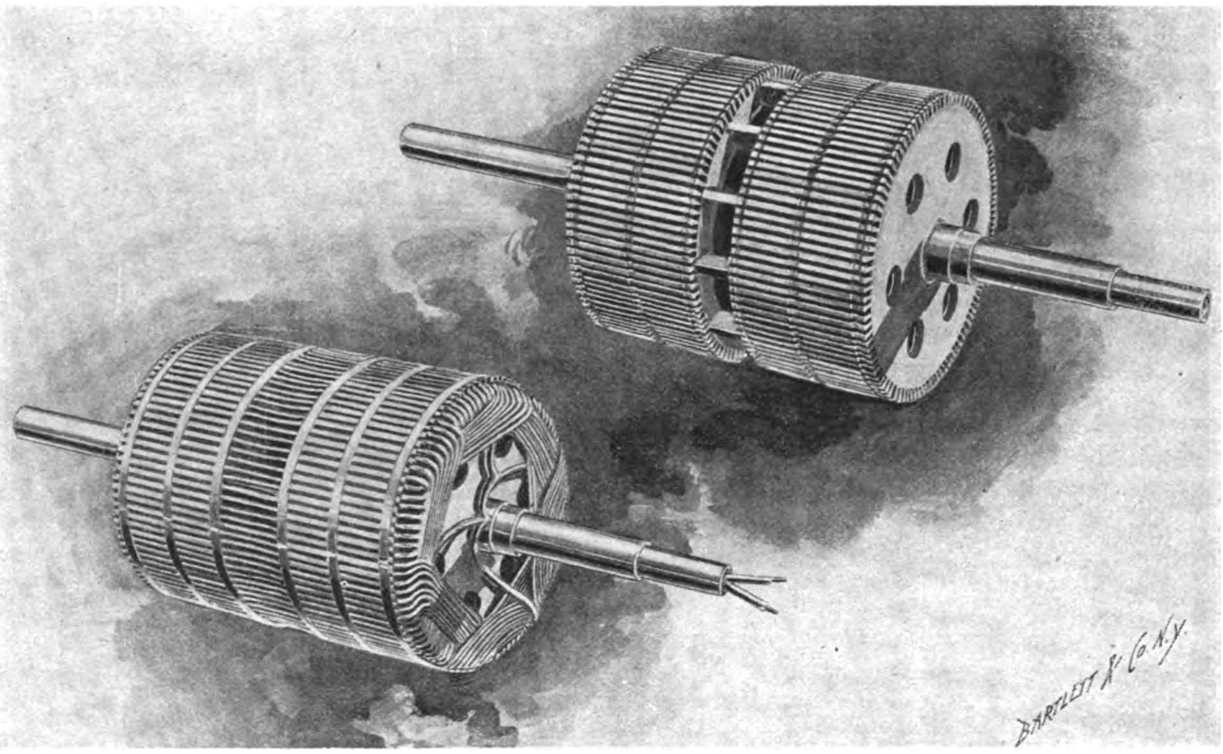

BARTLETT & Co. N.Y.

FIG. 6.—STANLEY ELECTRIC COMPANY'S NEW TWO-PHASE ALTERNATING APPARATUS.

The bearings in which the inductor rests are broad, substantial and self-oiling. The armature and field wires are brought out to a terminal board on the machine, and from this board the leads are taken off. The terminal board is of marbleized slate, one-half secured to the machine and the other being fastened as a cover. This cover is divided into compartments by partitions, so that each terminal is separated from every other. The wires are run direct from the coils and are in no way conspicuous, but are as much out of sight as possible. The terminal board and plan of connections have been very neatly devised. The absence of collector, commutator and loose wire is especially noticeable. The field or exciting coil is circular and wound on a copper spool which rests in the center of the machine surrounding the inductor. It is well insulated and well protected, being inclosed on three sides by the copper spool.

In Figs. 4, 5 and 6 is shown the two-phase motor. There are electrically two fields, which are fed by currents differing 90 degrees in phase, although mechanically there is but one. The winding is so connected that the wire, which lies directly under the poles on one armature, is in series with the wire lying between the poles on the other. In this position one-half of the machine acts as a transformer and the other half as a motor. The accompanying cuts show the armature both wound and unwound. The winding is not connected with the circuit, and the only current flowing is an induced current. The field coils are wound separately, and are, therefore, easily placed in position and insulated. A "compensating winding" is employed, which consists of short circuiting coils of high conductivity placed in the field poles for the purpose of neutralizing the self-induction of the armature. This method has greatly increased the starting torque above the running torque at full load.

One of the special features of this equipment is the use of the condenser, whose function is to make the motor take current in proportion to the load. They are connected in multiple with the fields of the motor, and when so placed supply the lagging component of the current. The false currents in this arrangement, instead of flowing back through the transformer line and generator, simply flow in a local circuit through the condenser. Thus lights or any other electrical apparatus are not disturbed by motors on the circuit. The efficiency of these motors is said to be about that of direct current motors. For a year and a half motors of this type have been used succesfully in Pittsfield.

The Card Single Motor Electric Railway Equipment.

The new single motor equipment for electric street railways manufactured by the Card Electric Co., of Mansfield, Ohio, possesses many interesting features. In studying the needs of electric railways the advantages of one and of two motors for a car were carefully considered by the engineers of the company. Although it seems to be the general practice and the common belief that each motor car should have two, yet, when the character of the service is considered, one motor for a large part of the railway now in operation seems to be sufficient. In large cities where the motor car is large and draws one, two or more trailers two motors are required, not because one motor would not do the work, but because the limited space under the car does not give room for the larger motor.

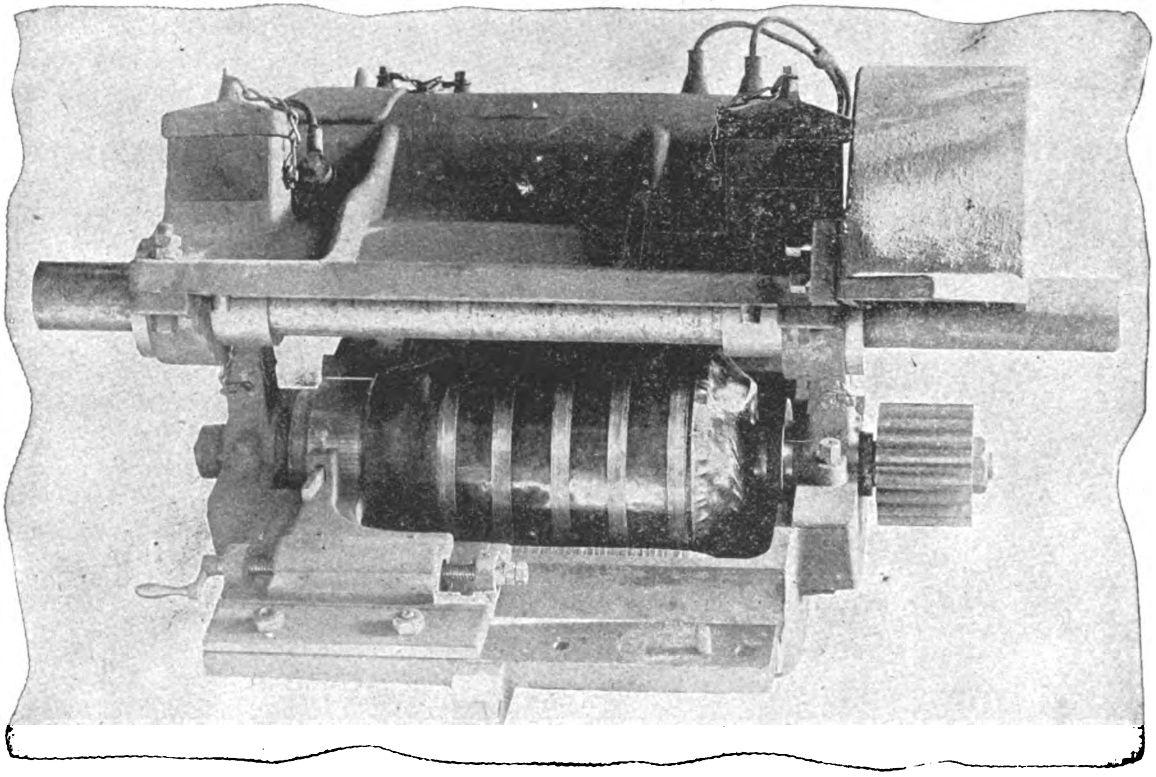
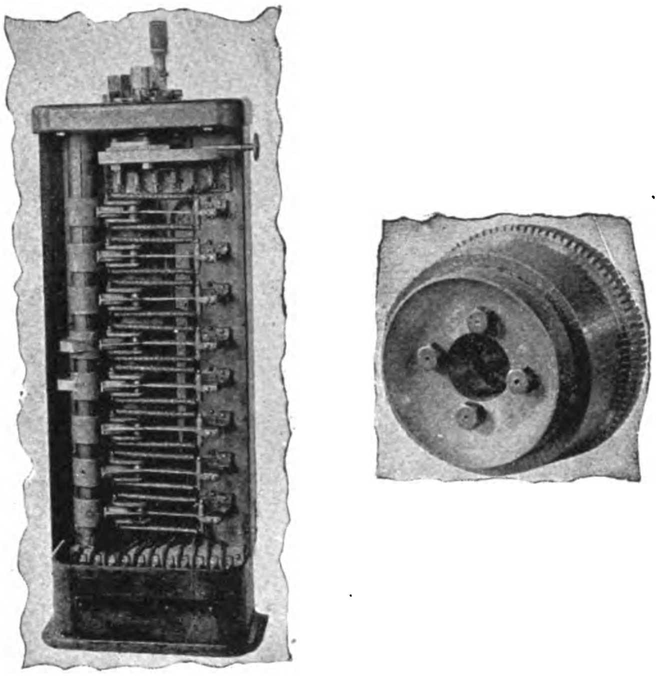


FIG. 1.—THE CARD SINGLE MOTOR ELECTRIC RAILWAY EQUIPMENT.

For use on hundreds of miles of track now laid and many more projected, the company believes the single motor equipment "the best and most profitable one to use." For use on lines having a heavier traffic a double motor equipment is being prepared which will possess all the valuable features of the one herewith described. The accompanying cuts show the motor complete and the several parts. The motor has been so designed that all working parts are within the cast frame of the motor, which excludes dust and moisture. This frame is well proportioned, giving strength where it is needed and avoiding a superfluous amount of metal which adds nothing but weight to the motor. One of the noticeable features is the steel bar which strengthens the cast extensions that form the spring supports. The bar rests in grooves and is clamped down by two eye bolts, giving four points of support. Provision is made for getting at the brushes easily and when the armature has to be taken out, the lower half of the case can be lowered and the armature rolled out on a plank. A small chain block fastened to a beam of the car body and to the lower half of the motor case, will enable one man to raise and lower it with ease. The screws and bolts are accessible and the work is quickly accomplished.

The armature has been skillfully designed. The core is built up of carefully selected iron, which is uniform in character. The shaft is four inches in diameter where it passes through the core, to which it is keyed with a one-inch key. The core is slotted to receive the coils. The slots are insulated by mica before the coils are placed in them, as are also the ends of the core. The field coils are wound on forms in two parts and covered separately. Muslin saturated with shellac is first wound on the coils, then two windings of waterproof tape, after which they are painted with compound and after being bound together are baked in a kiln. Thus a perfect insulation is secured and when placed on the pole pieces no part of the iron is in contact with the windings.

The commutator is one of the most important parts of the motor and has received its share of attention. It should be made as simple and strong as possible and capable of easy repair should any part show signs of wear. In this commutator, aside from the segments themselves, there are few parts and they are substantially put together. In the construction of the commutator the segments, which are of forged copper, are set up in a form insulated with mica and over them are driven rings of steel until further compression is impossible. When the end plates are put on and screwed down the strain is limited to a point where the plates can be removed without the use of a hammer. Between the hubs of the end plates is a rubber ring, which is of such size that when the commutator is on the shaft, it will fit the shaft snugly and make a perfect union, preventing any oil working into the armature or into the commutator. Should a segment, as sometimes happens, develop a soft spot and it be deemed best for the commutator to replace it with a new one, the armature may be placed on end, the commutator up, and by removing the four bolts and the end plate, the old segment can be taken out and the new segment put in its place; no wires need be soldered except those that connect with this segment; replace the end plate and put in the screws, being careful to draw them down easily and the change is made. The ends of the shaft are turned down smaller for the commutator and oil disc but not sufficiently to impair the strength or rigidity of the shaft.



FIGS. 2 AND 3.—THE CARD SINGLE MOTOR ELECTRIC RAILWAY EQUIPMENT.

For turning off commutators the company has perfected a very simple attachment that will enable the work to be done without the trouble of packing and shipping to the factory. The brush holders designed for this motor are fastened to the frame of the motor. Although not intended to be moved on their support they have a radical movement which give them an adjustment when the commutator becomes worn. The springs of the holders are turned on themselves several times, which insures sufficient flexibility and a constant pressure on the carbon brushes until they are worn out. The tension can be adjusted if desired by an attachment for that purpose. The wire terminals are fastened on the outside to the binding screws. Each car is equipped with two resistance boxes, which are connected in multiple. They are so constructed as to give a large radiating surface. The boxes are of well-seasoned maple lined with asbestos board. The coils are composed of wire wound on long spools and fastened with coach screws at regular intervals in the box. All connections are made within the box and any coil can be easily removed without disturbing the others.

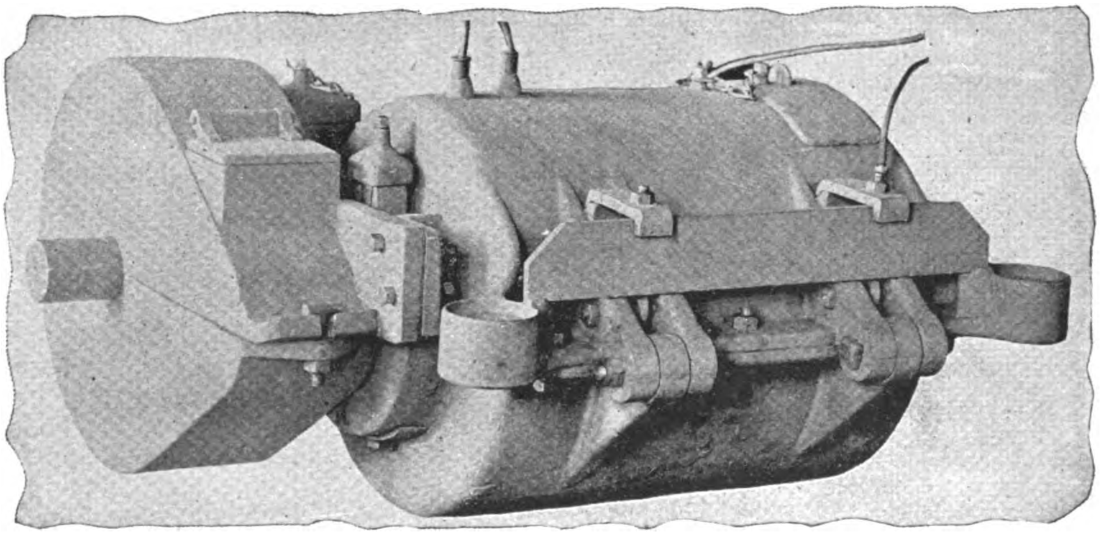


FIG. 4.—THE CARD SINGLE MOTOR ELECTRIC RAILWAY EQUIPMENT.

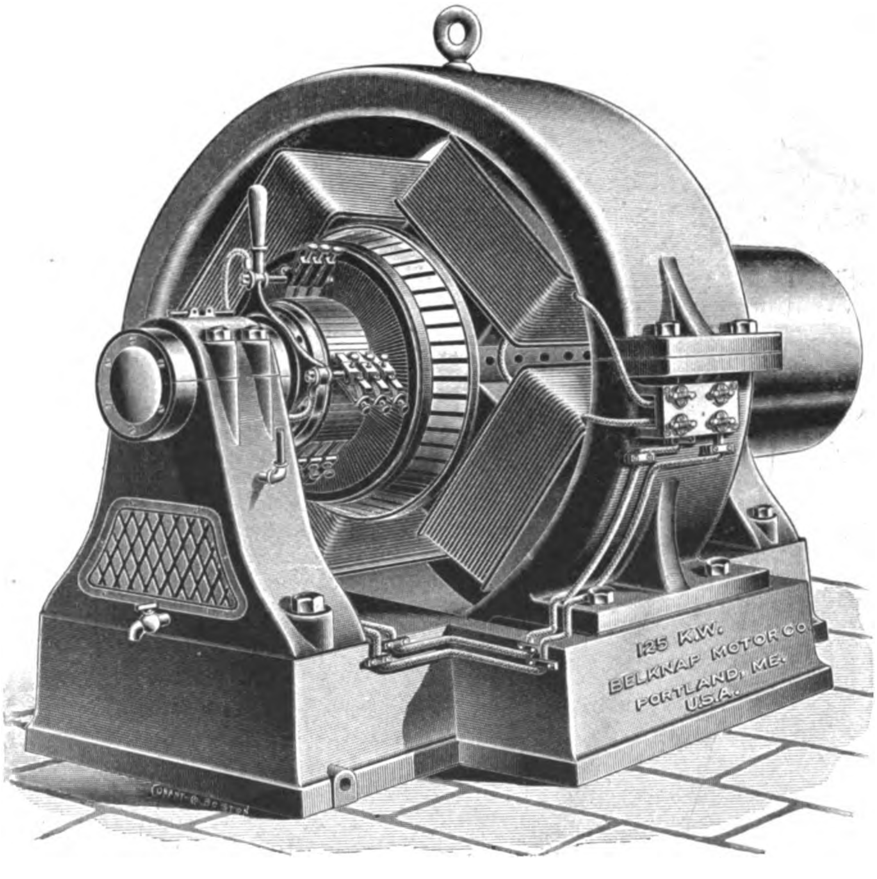
The controller, which is one of the important parts of the equipment, is of a very neat design. It has a tight case of sheet iron which excludes rain and dust. The mechanism is somewhat different from those in general use and will compare favorably with those on the market. The operating handle is placed in the center of the top and operates a shaft by means of two small sprocket wheels. On this shaft are eight cams insulated from it by means of hard rubber. Opposite each cam is a switch which is provided with contact pieces to engage with clips on binding blocks fastened to the back of the case, and at the bottom of the stand there is a series of binding blocks for making connection between controller, motor, resistance and the line. The cam gives a positive movement to the switch until it is just releasing from the contact clips, when the spring acts and throws it completely out. No matter how slow the handle may be turned there is no drawing of arcs or burning of contacts. Regarding the care of the controller it is worthy of mention that the switches are exact duplicates; the cams are the same. There is only one size of machine screw and one size of wood screw used in the stand, a matter of great importance in the care and repair of apparatus with many parts.

New Belknap Multipolar Generator.

The demand for large generators and motors, and the success which the Belknap Motor Company, of Portland, Me., has had in the manufacture and sale of the smaller machines, has induced it to build larger generators for street railway and power plants. The multipolar generator shown in the accompanying cut has but recently been designed and built for the trade. In order to turn out these machines it was necessary to enlarge the factory and increase the equipment which is now completed with ample facilities to fill any orders. This generator is of 125 kilowatts capacity, four poles, and designed for power house service. The frame of the machine is in several parts, making it easier to handle. The parts are so divided that when being erected the parts come together most handily, and where apparatus for handling heavy machinery is not to be had the subdivision of the frame enables the generator to be erected by hand.

The bed of the frame is planed to fit iron slides, and is rigidly constructed so as to form a firm foundation for the heavy field magnets. The yoke is in two castings, which together form a complete circle. The fields project inwardly from the yoke, and the pole pieces are bored and fitted with a pole bushing surrounding the armature which prevents the humming often noticed with toothed armatures. The armature is of the toothed drum type, and in its construction by a system of end connections, crossing of the conductors is avoided, reducing the danger of burnouts and placing each wire where it is easy of access.

The commutator is large, constructed of forged segments, insulated by carefully selected mica. The brush holders are of new design, and the brushes furnished are the Belknap woven wire and graphite brushes which have previously been described in this journal. The bearings which are supported by heavy pillow blocks are large, self-oiling and self-aligning. The field coils are compound wound, and the machine has been carefully designed with reference to the magnetic circuit. The workmanship throughout is of the best, and the machine should prove both durable and efficient. The electrical machines of the Belknap Motor Company, have already had a large sale, and this addition to the already extensive line of goods places the company in a still better position to meet the wants of its customers.


125 K.W.
BELKNAP MOTOR CO.
PORTLAND, ME.
U.S.A.

NEW BELKNAP MULTIPOLAR GENERATOR.

The Second Avenue Traction Co., Pittsburg, will shortly make a complete change in its system of power stations. The plants at Soho and Braddock will be discontinued and a new plant built at Glenwood.

Patent Grooved Sable Rawhide Belting.

The manufacturers of belting are not behind in the general improvement that has been made in the apparatus of the power station. The belting performs a most important service in nearly every station. Rawhide has been largely used for this service, and as the character of the work has changed the manufacture of the belting has changed. The sable rawhide belting is one of the belts which are of modern manufacture, involving in its making new ideas. It is made by the Shultz Belting Co., of St. Louis. Instead of being tanned all the way through, as in oak-tanned belting, it is tanned only on the surface. An interior of rawhide is thus preserved with its original strength and durability. The driving surface is capable of a better contact with the pulley. A belt made in this manner has been found so efficient in the transmission of power that the manufacturers are ready to guarantee its capacity to be 25 to 33 per cent more than any other belt.

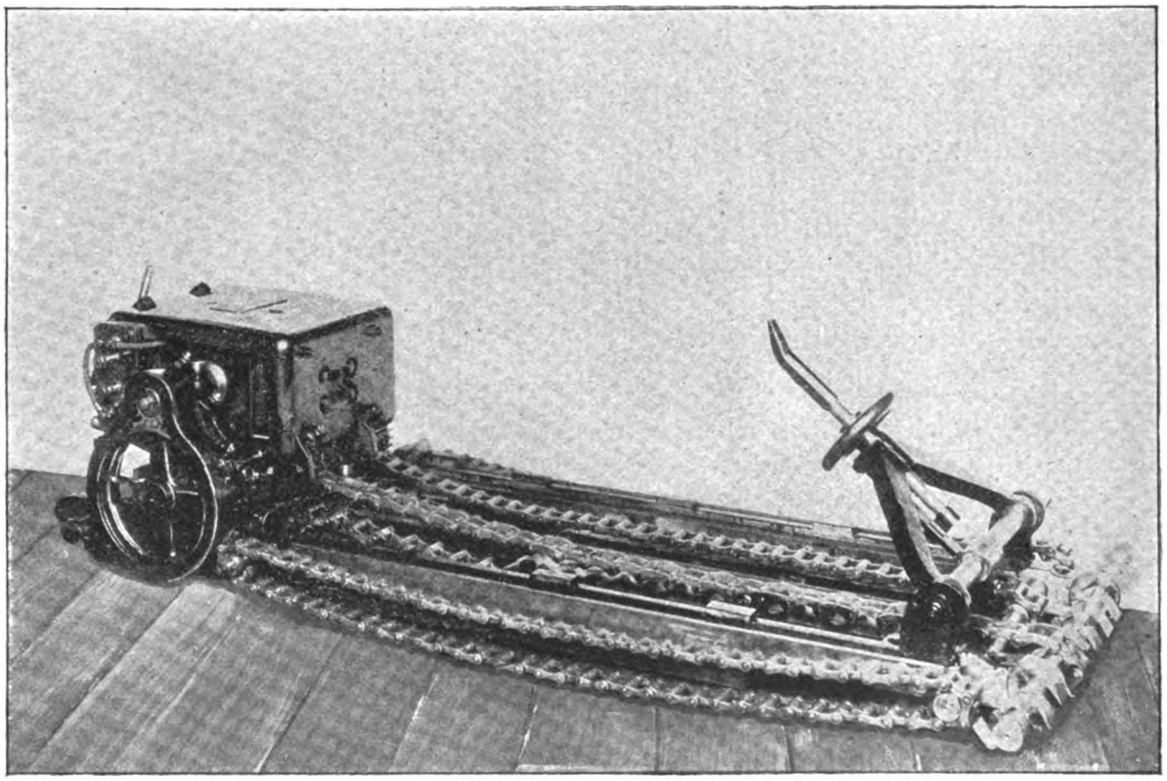
PATENT GROOVED SABLE RAWHIDE BELTING.

The patent grooved belt is made of this belting, but with grooves running lengthwise. These serve as channels to permit the escape of air from between belt and pulley and overcomes the air cushion, which makes it possible to run the belt nearly as slack as link belts. There is no danger of the grooves becoming stopped up, as the current of air keeps them clear. The belt runs smoothly and noiselessly.

Electrical Coal Cutter.

The illustration shows a new device for cutting coal, which has just been designed and perfected by the General Electric Company. It is known as R. B. 40 and is of the rotating bar type. It consists principally of a bed frame of two steel channel bars firmly braced. Mounted upon and enaging with this bed frame is a sliding frame similarly braced, consisting of two steel bars, at the rear end of which is mounted an ironclad multipolar electric motor, communicating power to the feed and driving mechanism. The front end of this sliding frame carries the cutter bar, into which the cutters or bits of tool steel are held by set screws. When the cutter bar is revolved, these cutters or bits cover its entire face.

The bar is driven by an endless chain, and as it is revolved, is advanced by the feed mechanism into the coal or other material to be cut, to the desired depth. The cuttings are brought out to the face of the coal by means of cleaner chains. This machine is operated by two men; one in charge of the machine and the other as a helper. A carriage is furnished with the machine which enables it to be handled with ease. The machine is taken into the mine on this carriage and run into the room to be undercut. It is then placed on two skid boards in front of the coal at one side of the room or entry to be under-cut, and is fastened firmly by means of the front and rear jacks which are braced against the face and roof of the coal. These prevent the machine from moving when in operation. The power is then turned on by the machine runner, and the machine proceeds to its work.



ELECTRICAL COAL CUTTER.

The cutter bar, which is revolved by an endless chain, is fed forward to a depth of five or six feet, according to the size of the machine. The usual length of the cutter bar is 39 inches, but 42 or 48-inch bars can be used where the cutting is not too hard. When the full depth is reached, the feed is thrown off, and by means of a reverse lever the cutter bar is withdrawn to its starting point and automatically stopped. This completes the cut, and the machine is moved over the length of the cutter bar used and another cut made in the same manner. This is continued until the entire width of the room or entry is undercut, after which the machine is again loaded on the carriage and taken into another room.

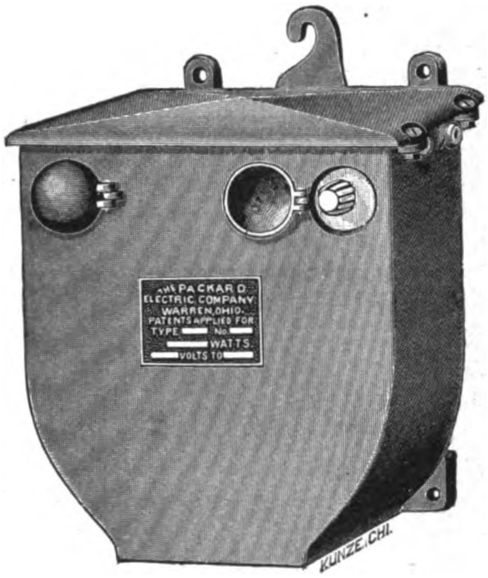


FIG. 1.—THE PACKARD CONVERTER CUTOUT.

The cuts are made in from four to six minutes. The amount of coal under-cut or the lineal feet face for each machine depends upon the quality of the coal and the skill of the man handling it. The construction of this machine is extremely simple, and any person of ordinary intelligence can understand and handle it with a few days' instructions. All parts are made in duplicate and are interchangeable.

A quarterly dividend of 1¾ per cent on the preferred stock was declared at the meeting of the directors of the Westinghouse Company last month. It will be paid to stockholders of record on July 2d.

The Packard Converter Cut-Out.

For use in connection with the Packard Transformer with which the trade in general is pretty thoroughly familiar, the Packard Electric Company has brought out an improved cut-out. In design it is very much different from any that have previously been placed on the market. The many important features a successful transformer cut-out must possess seem to embodied in this one, and it will probably greatly increase the popularity of this transformer. In Fig. 1 is shown the cut-out inserted in the transformer which was fully described in a previous issue. As will be noticed it is thoroughly protected when in place from all outside injury, and the cut-out box being entirely within the case is not in any way an incumberance. It is handy to get at when fuse has been blown, and easily exchanged for one with new fuse. The hinged cover conceals the porcelain handle; requires no tools to open it when a new fuse is wanted. The plugs are all made inter-changeable so that a new plug can be shipped in and the old one refused and used again. The time required in changing plugs is so short as not to be considered.

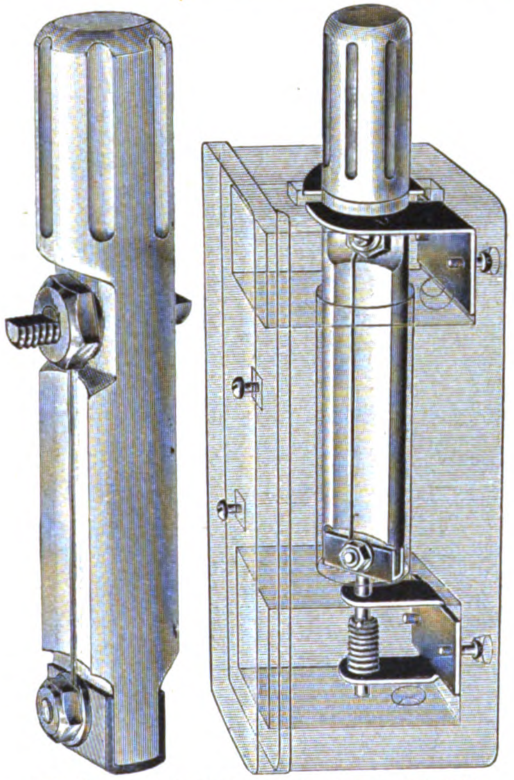


FIG. 2.—THE PACKARD CONVERTER CUT-OUT.

The cut Fig. 2 shows the porcelain plug which is grooved on one side for the fuse wire. One end of the plug is covered with metal strip having on the side with the groove a binding screw which holds the end of the fuse wire. Another lug extends through the piece of porcelain, making a double contact with the metal surfaces in the cut-out block. Thus the fuse wire forms the connecting link between the ends of the circuit in the cut-out box. The cut-out box is a heavy piece of porcelain and is not easily damaged. At either end of the box are two compartments containing the terminals. The first of these is in the form of a plate with slot through the center, through which the lugs on the fuse plug pass. The farther contact consists of a rod which bears against the recess in the end of the plug, being held by a spring. When the plug has been inserted it is turned a quarter of a revolution and the double lugs press against the forward contact plate. Perfect contacts are always assured which require no attention except in case the fuse should be blown. The fuse box and plug are made of the best glazed porcelain that is not easily injured and is a good insulator. The manufacturers are confident of the favor of users of transformers for this most important part of the transformer. The Electric Appliance Company of Chicago, the general western agents for the Packard company, has already placed them before the trade in the west, where they have been well received.

New Automatic Oiling System.

A new system of automatically oiling all moving parts of the various machines of a power plant has been placed upon the market by the Wilson-Whiting Davis Oiling Company of the Mutual Reserve Building, New York city. The system secures for each bearing its proper amount of oil from a common source of supply. It insures a positive automatic oiling of the machinery under a pressure sufficient to overcome all obstacles ordinarily encountered and does away with the manual labor required where hand-fed cups are used. A guaranteed saving of from 20 to 40 per cent is made.

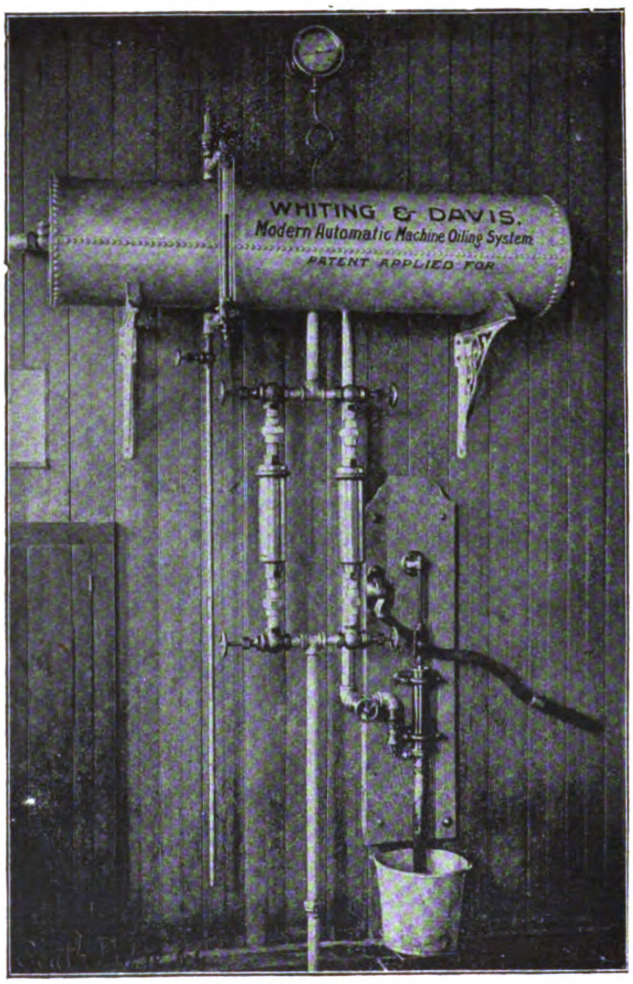


FIG. 1.—NEW AUTOMATIC OILING SYSTEM.

The method provides clean oil always and whatever waste oil there may be, can be saved and used again. There is very little mechanism to get out of order and the system may be considered absolutely reliable. Carelessness or lack of attention on the part of attendants has ruined many bearings but the supply of oil in the tank, which is drawn upon, should not be likely to fail. Each cup is controlled by a separate valve and if at any time a machine is shut down it is necessary to close but one valve. The amount fed by each cup is adjusted by a screw at top which can flood the bearing, if necessary, or give a steady, accurate supply of oil.

In Fig. 1 is shown the apparatus required to operate the system. This consists of an iron tank of such a capacity as the size of the plant requires, into which the oil is pumped from the barrel or filter. Pressure is applied to the oil by the same pump to such an amount as may be desired, forcing the oil through the filters below the tank into the main supply pipe, thence through concealed branches to the different machines and cups. When the number of cups exceeds 125 or the machinery is on different floors an automatic compressor is provided to further insure the constancy of the pressure. The two filters, as provided, permit one to be taken out for cleaning or repair, leaving one in use. The main outlet pipe extends several inches above the bottom of the tank so that any sediment or foreign matter cannot enter the pipes.

The tank and accompanying apparatus may be placed in any part of the engine room or adjoining room. If in sight and near at hand it is much more convenient for the engineer. In Fig. 2 is shown the oil cups and connections on an arc machine. The system is applicable to any kind of machinery and where used on electrical machinery the cups are insulated if desired. In order to suit the tastes of engineers the pipes and connections are finished in several styles, brass or nickel plated. Each style is very durable and well made, and the character of the service is such that the entire system will wear as long as any machinery of the station. The pipes are so placed as not to interfere with the operation or care of the machines.

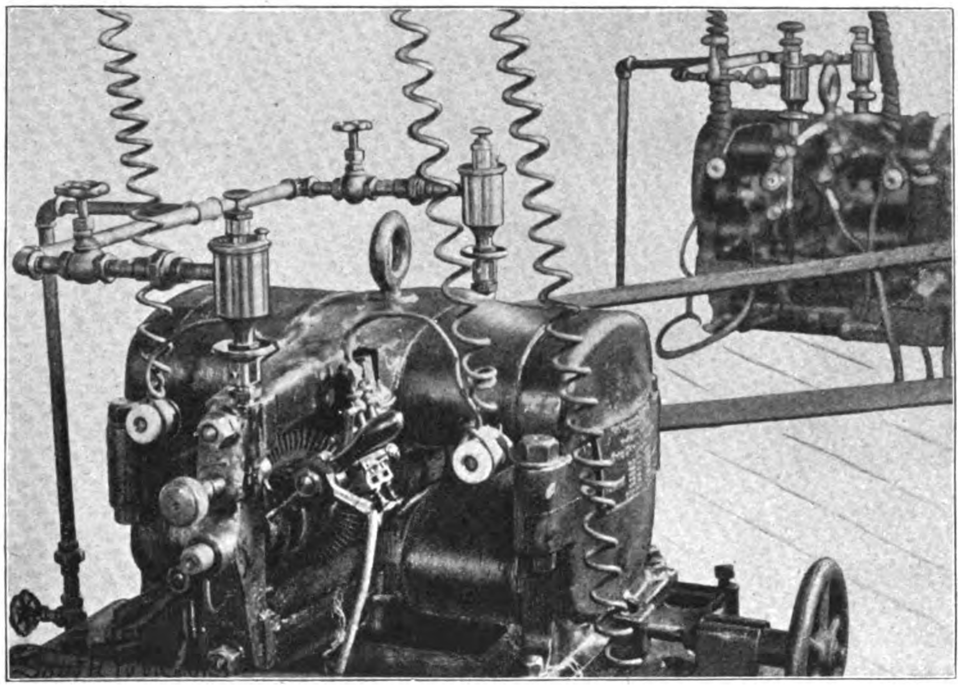


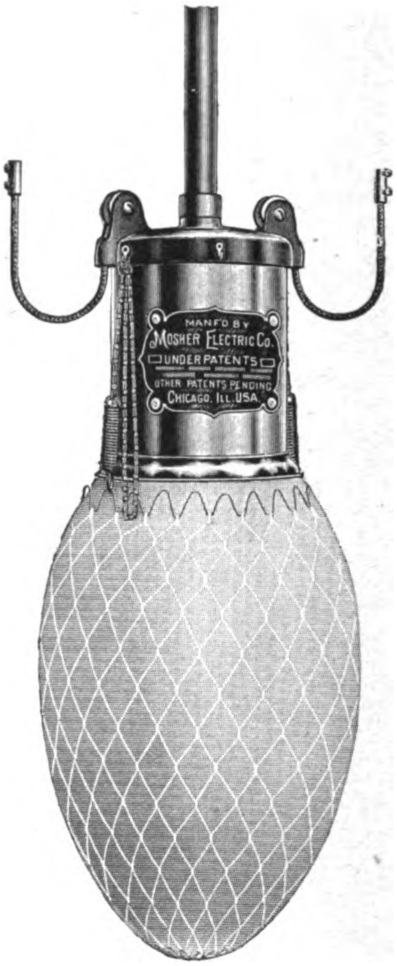
FIG. 2.—NEW AUTOMATIC OILING SYSTEM.

Postal Cars on Chicago Street Railways.

Postmaster Hesing held a conference with the managers of the street railway systems of Chicago, to make arrangements for the introduction of a new postal service, which will utilize the street railways for carrying the local mails. Three propositions were offered. One was for the companies to build mail cars to be run as trailers. These cars would be fitted up so that the mail could be sorted on route. The second plan was to place messengers who would have a space reserved, on the cars to receive and exchange pouches. The third plan was that the companies should themselves carry the mail which would be in charge of the conductors. Although nothing definite has so far been done, yet we may look for something of the kind in the near future.

The New Mosher Arc Lamp.

The accompanying cut represents the new Mosher arc lamp for alternating current circuits. The lamp is placed on the market after considerable expense and labor in perfecting the details of its mechanism. One of the special features of the lamp is the introduction of a wire which will stand a heat of 1,080 degrees F., and will not become brittle or stretch by continual use. The lamp contains no magnets. The amount of current which would burn out an ordinary magnet, does not in any way injure this lamp. It will handle perfectly changes of voltage from 25 to 35 volts, and will stand 40 without damaging the wire. Its operation is noiseless and without the sputtering that usually accompanies the feeding of the carbon.

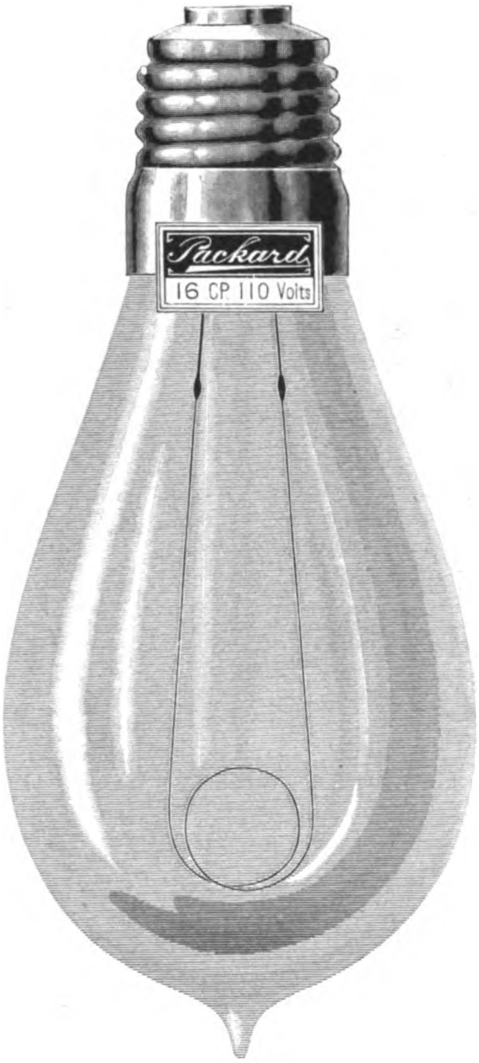


NEW MOSHER ARC LAMP.

The lamp will operate well on the 30-volt secondary from any standard make of transformer. The regulation is effected by the expansion and contraction of this special wire, which has proved very reliable in service. The parts of the lamp are made by skilled machinists and electricians and are durable and efficient. The design shows neat outlines and substantial parts. The globe which covers the lower part of the lamp, serves as a perfect spark arrester. This lamp is manufactured and sold by the Union Brass Manufacturing Company, of Chicago, which is a company of recent organization, but is composed of men who have long been connected with the industry, and is in possession of a plant and equipment complete in every particular.

The Packard Coiled Filament Lamp.

The New York & Ohio Company has made many innovations in the manufacture of incandescent lamps since it started that branch of its business. Among the new styles the company has brought out have been lamps for low as well as high candle-power and lamps with many special features. In the accompanying cut is illustrated the coiled filament lamp. At the lower end of the loop the filament is made into a coil. This coil renders the carbon steadier and not so apt to be injured by the jars due to unstaple supports or any other cause. The filament is less apt to fall toward the side of the globe, which shortens its life and when it touches the glass usually destroys itself. The coil also concentrates the light at the lower part of the bulb, making it more satisfactory for all purposes.



THE PACKARD COILED FILAMENT LAMP.

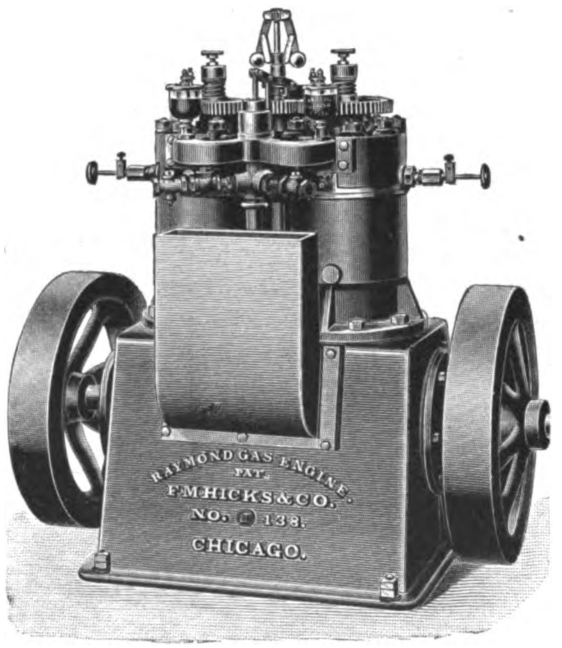
These lamps are now made for voltages of 100 and 110. The shape of the filament is neat and when the lamp is in use it makes it more attractive. The company has endeavored to make the lamps as near perfect as possible and to each detail of the construction have given most careful attention. The goods of the New York & Ohio Company are well-known in the west through its enterprising agent, the Electric Appliance Company, of Chicago, which carries a full stock of the Packard apparatus and specialties.

The recent decision of the city attorney of Milwaukee, concerning the manner of taxing corporations, will increase, it is said, the taxes of the Milwaukee street railway from $20,000 to $100,000 per year. The company will bring the matter before the courts.

The Raymond Gas Engine for Electric Plants.

To those interested in the installation of isolated electric lighting plants an investigation of the Raymond gas engine, illustrated in the accompanying cut, will be found of interest. This branch of the electrical industry has never received the attention it deserved, partly because of the lack of a satisfactory motor for the service and partly because the manufacturers of electrical apparatus have given their attention to larger work. This engine has proved so satisfactory in every respect that we may look for considerable activity in this field. The engine is manufactured by F. M. Hicks & Co., 68 and 70 S. Canal St., Chicago.

The engine can be operated by natural gas, manufacturing gas or gasoline. The economy of the gas engine is not questioned since it requires but 20 cubic feet per horsepower to operate. The special features of this engine which adapts it for electric lighting service are the even high speed, easy starting, noiseless running and little attention required. It has been most difficult to secure an even speed with gas engines, but the inventor of this engine has most ingeniously secured the desired result. The engine is started by the explosion of a cartridge in the cylinder, which gives an impulse to the fly wheel.


RAYMOND GAS ENGINE.
PAT.
F.M.HICKS&CO.
NO. 138.
CHICAGO.

THE RAYMOND GAS ENGINE.

The engine runs noiselessly and there is no waste of gas. When the load is much less than the capacity of the engine, only such an amount of gas will be consumed as is actually required for the work. The engine can be run by any person of ordinary intelligence, and skilled engineers are not necessary. One hour a day is all that is necessary to care for the engine, so that the attention it requires is very small indeed. The high speed at which it runs is a desirable feature for running small machines. The engine may be direct connected or belted to the dynamo which permits a plant to be placed in a small space.

This gas engine is successfully used in factories, mills, office buildings, flats and apartment houses for operating isolated plant; so successful has it been that the company is barely able to supply the orders for engines. A number of plants have been installed in Chicago and at the company's works will be found a plant in operation. The orders for these engines have come from all the neighboring states;

for summer residences and hotels a more suitable power plant could not be devised. But a small amount of labor is necessary, no boiler room, economical and reliable source of power.

A BRIEF REVIEW.

THE WATER-POWER REVIVAL.

The utilization of water-power probably antedates written history, the interval between crude and primitive methods and the latest triumph of engineering skill at the Niagara Falls covering the entire period of human progress and civilization. Here and there where the bones of extinct races have mouldered into dust and centuries of time have been silent and blank, traces have been left of man's attempt to utilize the running stream and the falling cataract. Down to our own immediate times and in sundry fashions and places the water-wheel and the dam have been familiar objects.

It has, however, been left till the advent of electricity for the real value and scope of this force to be generally recognized. By this means the conveyance of power to great distances has been made possible, its service being no longer limited to immediate localities. It is in this sense that natural forces are multiplied by extending their area of service, and each new science as developed becomes the handmaiden of the rest. In fact, none are complete till all are a unit, and till the last is added the rest are immature. Electricity promises to be one of the most potential of modern forces in making this fusion, and in the wide distribution of energy from waterfalls may practically revolutionize industrial conditions.

The Niagara example, from its conception to its present stage, has been a matter of world-wide interest. The project was of so daring a nature, invading one of the most historic and magnificent cataracts on the globe, and its results, if successful, of so important a nature, that it can be truthfully said no modern engineering enterprise has been watched with greater interest. The practical nature of this interest is shown by efforts made both in this country and in others to make the best use of water-power. There is not a waterfall of any magnitude in any industrial nation on which the eye of utilization does not forecast its commercial possibilities. This is true even to the heart of Africa, where the falls of Nyanza have for centuries been thundering in their tropical solitudes.

In this country, where enterprise is alert to any and every advantage, the revival of interest in water-power is spontaneous and general. On the list of projects in process or contemplation is the utilization of a 1,200-foot dam across a portion of the St. Lawrence river, which, it is claimed, can be made to yield 50,000 horse-power in electricity without change, and by contemplated alteration it is expected to develop a capacity of 200,000 to 300,000 horse-power. The chief engineer of the Niagara tunnel is to have charge of construction. The Great Falls of the Potomac are to be utilized, plans being matured to supply Washington and vicinity with light, heat and power from these falls. The water-power of the Yadkin Narrows in North Carolina is, according to the geologist of the State, capable of generating electricity on an extensive scale. Among other enterprises is the utilization of a waterfall on the San Gabriel River, California, where an electrical plant is to be constructed for mills in the vicinity. A dam is to be built in the Lake of the Woods, Canada, to generate electricity. At Spokane, Wash., the water of the falls has been tapped at one point, the power gained being remarkable. One power station, fed by two flumes (boiler iron, eight feet in diameter) from small dam and flumed with 40-foot drop, turns 40 twin turbines. The electric current thus developed runs all the street car and cable lines in the city, the city lighting, flouring mills and elevators in the chief high building. There can be no doubt but that this revival of interest will continue and keep pace with our industrial progress wherever water-power is economically available.—Age of Steel.

GERMAN CENTRAL STATION STATISTICS.

The value of reliable statistics properly classified and digested is too well known to require special pointing out, but it is sometimes forgotten that they are especially valuable when relating to new industries such as electric lighting and power distribution. Various attempts have been made by the National Electric Light Association to supply this very necessary data, but the work thus far accomplished must be regarded as but a tithe of that necessary to enable the central station manager to compare the operation of his own station with that of others. Thus, at the last convention held in Washington the statistics submitted were limited practically to the consumption of coal per horse power hour in central stations. This was good enough in itself but manifestly it covered but a part of the working of a central station. It may be that the lack of information necessary to draw up comparative statistics is due to the loose or inadequate methods of book-keeping employed in the majority of central stations in this country, and perhaps the National Electric Light Association could do no better than to start anew in its statistical work by indicating a method of keeping accounts which would enable central stations to fill out the information blanks by a rapid inspection of their books. Such blanks for keeping station accounts are available, among others those prepared by Mr. Horatio A. Foster, and the adoption of a uniform set something after the same plan by all stations would make the matter of obtaining reliable station statistics a comparatively easy task.

In marked contrast to the American lack of data in this respect are the statistics from Germany. We have before us two statistical compilations, one embodying the work of the German Elektrotechnische Verein and the other that of the "Free Association of Electric Light Station Representatives." Naturally both sets of statistics cover much of the same ground, but they differ somewhat in their modes of tabulation and each has a distinct value of its own. That of the Elektrotechnische Verein gives the tabulated results of central stations in 24 cities, including four having over 250,000 inhabitants, seven between 75,000 and 250,000, seven between 10,000 and 75,000, and six under 10,000. These stations employ probably all the various ordinary methods of generation and distribution and allow some quite definite conclusions to be reached on hitherto doubtful points.

Comparing the cities for current capacity installed per 1,000 inhabitants we find it to vary considerably and, as would hardly be expected on first consideration, to average higher in smaller cities than in the larger ones. It amounts in Berlin to 5.81 kilowatts per 1,000 inhabitants. A glance at the cities of the third group shows that the consumption of current is largely increased by the adoption of a sliding scale. The proportional distribution of lighting in hotels, dwellings, theaters, etc., varies of course with the character of each city. Thus, whereas in Berlin the percentage of current furnished to dwellings and hotels is only 19.9 per cent of the total consumption, it amounts to 38.7 per cent in Hamburg. A greater constancy in this respect is shown in store illumination, at least in the larger cities, where 30 per cent of the total is about the average of current consumed in such places. This is in marked contrast to the figures in the United States in which hotels and private dwellings represent but a small fraction of the current consumed, by far the largest percentage being devoted to store and office illumination. This fact is due, in part, probably to the larger number of isolated plants in the United States. Factory lighting represents but a small fraction of the whole, which is easily accounted for. Unfortunately the data on street illumination is incomplete, so that no comparison can be made in this respect.

The amount of electric power consumed in German cities is of special interest. From the tables it would seem that the cities of medium size employ but very small quantities, whereas the larger cities take proportionately more current for this purpose. Thus Berlin and Vienna employ, respectively, 8.6 and 6.8 per cent of the total current generated, for power purposes. Glancing at the actual electrical energy consumed we note that Berlin stands at the head with 6,700,000 kilowatt hours per annum, followed by Vienna with 1,300,000; then comes Hamburg with 500,000 and s'Gravenhagan, Dusseldorf and Elberfeld with 300,000 each.

The charges for current in Germany show a most varied practice. A fixed charge per lamp installed is exacted in Berlin and Innsbruck. In Vienna-Mariahilf this charge is waived beyond 100 lamp hours per lamp. In Heilbronn a charge is only made for the first 10 incandescent lamps or the first two arc lamps; in the first case $1.87, amd in later $10. A sliding scale is in vogue in several cities. The cheapest rates are to be found in Triberg where the lamps are divided into three groups. The first group includes such lamps as are burnt in winter and summer at definite times; the second, lamps which are burnt only in winter or only in summer; and third, lamps which are used temporarily only. The prices are also graded according to whether the lamps are used in hotels, dwellings, stores or factories. There result from this no fewer than 12 different rates of charge varying from $9 to $90 per kilowatt per annum.

The average price of current in stations selling by meter is a little over 18 cents per killowatt hour, the highest being 52½ cents, but the discounts vary considerably in different localities. The rates for electric power are arranged on a variety of plans. In Dusseldorf and Hamburg each case is treated individually and a special price fixed. In other cities there are flat rates without discount, as in Barmen, Berlin, Stockholm and other cities. The highest price is that in vogue at Gummersbach, namely, 13 cents per kilowatt hour. In Berlin, however, the low price of 5 cents obtains, while at Triberg power is actually sold at 2½ cents per kilowatt hour. It goes without saying that current for power purposes can be furnished at a lower cost than for lighting, but one is hardly prepared for such generally low prices, as these statistics show. For those who argue that the electric light and electric power are luxuries, the German statistics will prove a revelation. They show, in fact, that in the larger cities electric light is but slightly dearer than gaslight, but that electric motive power is still considerably dearer than gas engine power, leaving out of consideration, of course, the question of convenience and considering merely the relative cost of gas and current. On the other hand it is shown that in many of the smaller cities the electric light is far cheaper than gas, and electric power much cheaper than gas power. In several instances the electric light is successfully competing with petroleum. The results here shown would indicate that the Germans are just waking up to the fact that there is a profitable busidess to be done in small towns as has proved to be the case in this country when the stations are properly managed.

Of the cities tabulated, the large majority are operated on the continuous current plan and of these a large percentage are equipped with storage batteries. The figures show that all these stations exhibit by far the greatest economy in fuel consumption. The best result thus far obtained is that recorded of the storage battery station at Altoona, namely: .413 kilowatt hour of current delivered to mains for 1 kilogram of coal, that is, close to four pounds of coal per horse-power per hour, or 5.3 pounds per kilowatt hour of current delivered. The table of the National Electric Light Association submitted at the last meeting showed an average of 91.7 watt hours per pound of coal and a maximum of 208, while in the case of Altoona the economy is 190 watt hours. But the point to be considered is that while the 208 watt hours per pound of coal was obtained with a station having a capacity of 8,000,000 watt hours per day, the 190 watt hours per pound of coal at Altoona were obtained with a station of only 468,000 watt hours capacity per day. There is food for thought in this showing and it ought to have some influence on future work in America. We would respectfully suggest to the committee on data of the National Electric Light Association a close study of the German statistics which contain much that may be embodied in their own work. We recognise that it is one thing to get up a statistical blank, and quite another to have it filled out properly and returned; but by giving ample time to the companies some improvement over the results heretofore obtained ought to be secured.—Electrical Engineer.

TAUSSIG'S ELECTRIC SMELTING PROCESS.

Among the recent German inventions in metallurgy, one of the most interesting, by reason of its simplicity and its probable value in practical application, is a process invented by Mr. Edward Taussig, of Bahrenfeld, for the smelting and casting of metals by electrical heat, under the influence of rarefied air. The operation consists in fusing ores or metals in a closed furnace or chamber, the hearth of which is connected with molds into which the fused metal flows by gravitation, and is cast into any desired form, and in both of which (molds and furnace) the air has been rarefied as far as practicable through exhaustion by air pumps or other mechanical means.

The apparatus includes a long, air-tight smelting channel or chamber, the hearth of which inclines to a central orifice, through which the fused metal passes into the molds. This chamber is filled with the metal to be smelted, and heat is generated by passing an adequate current of electricity through the mass without the use of any kind of fuel, or the employment of carbon electrodes. In this latter respect the inventor of this process claims that it is entirely original and distinct.

The furnace is lined with glazed fire bricks, which are so efficient a non-conductor as to insulate quite perfectly the contents of the chamber, so that the heat is developed where it is required evenly throughout the mass, and very little, if any, loss of current is experienced. From the testimony of experts who have examined this process of operation, it appears that a degree of heat sufficient to smelt pig iron in 15 minutes can be generated and maintained without unduly heating the other parts of the circuit, and this is equally true of the smelting of easily fused metals, like lead and zinc, and of Siemens-Martin steel of Swedish origin.

The entire absence of coke, coal, or carbon electrodes secures to the fused metal nearly absolute purity, and the continued exhaustion of air and the gases generated by smelting increases the fluidity of the molten material and wholly prevents oxidation and blistering and produces castings of a dense, smooth quality; which have shown, under elaborate tests made by unimpeachable authority, the highest mechanical qualities of which cast iron is capable.

The record of actual results with this process are reported to be:

1. It has been shown that by this process a degree of heat sufficient to smelt a ton or more of iron within fifteen minutes may be generated, sustained and applied at will without the use of carbon electrodes and without excessive heating or injury to other portions of the circuit.

2. Castings of iron and steel, up to a weight of 200 pounds or more, have been made, which have shown all the desirable qualities—smoothness of surface, fineness of texture and freedom from much of the impurities which are always more or less incident to smelting by ordinary methods.

3. Pig iron of excellent quality has been produced in small quantities by direct smelting from Swedish ores. The tests of this iron, as made by the Royal School of Mines at Berlin, have been published in several technical journals. These tables may be summarized in the statement that the tractile strength of a round rod 10 millimeters in diameter was 3,410 pounds, and the resistance to compression of a rod 301 millimeters in length and 30 millimeters in diameter was 57,850 kilograms, or 127,270 pounds.—Electrical Review.

MOTOR INSPECTION.

Mr. William M. Ramsay, general superintendent of the Federal Street and Pleasant Valley Passenger Railway, Pittsburg, has the following to say in the last issue of the Street Railway Review regarding motor inspection. The inspection of motors, like many other subjects in our profession, is one upon which a variety of views has been expressed. All agree, however, that motor inspection of some nature is an imperative necessity. The differences of opinion are as to the frequency and to the method of inspection. As to the frequency of the inspection, it is the experience of the writer that managers operating nearly any of the older types of motors, Edison or Sprague No. 6, or any of the T.-H. double reduction types, will find it to their advantage to have a superficial inspection not less than three times each day, in addition to the more thorough nightly inspection. By superficial inspection, is meant an examination of each bearing, and of the brushes of the machines. The inspection of wires—field wires and brush terminals—is of so much importance that it had better to be left undone than done in the manner which is almost universally practiced by thoughtless inspectors and shop-men. The usual method is to take hold of a wire and pull it more or less gently to see if it is loose at the terminal or broken under its insulation. The obvious result of this is, that wires which might last for years if untouched, are worn out in a few months by such barbarous handling, and a constant wail of "broken field wire," or "another loose brush terminal," is heard from motormen and conductors. Motormen and conductors, themselves, soon learn to look for trouble first from broken wires, and like inspectors, pull and jerk the wires every time their car "bucks," and so matters grow worse, and will continue to grow worse until the manager makes it a punishable offence to any one, except the shop foreman, for instance, to pull a wire or to lay hands upon a motor wire. The writer has in use upon about 120 motors of the Sprague No. 6 type, a "motor board," designed especially to obviate the trouble of loose wires. It has the usual six terminals of binding posts, separated by a partition of ash, one inch high. The placing of the cover on the board fastens each wire down to the board for a distance of about one inch and-a-half from its entrance to the binding post. This prevents the ordinary vibration of the wires from causing a break at the binding post. The cover of the board is fastened at each corner with a flat-headed wood screw, countersunk about a quarter of an inch, and shellac or sealing-wax poured over the head to indicate any removal of the cover by unauthorized parties. "Hands off," is painted in large letters upon the cover. It is found that by enforcing these rules that wires will last almost indefinitely, the effect of the oscillation of the car and motors not being enough to be noticeable even after a long time.

The nightly inspection should be most thorough. A point seldom thought of in the inspection of the new iron clad motors is the external cleaning of the fields and field magnets. Carbon dust and street dust accumulates about the field coils, and becoming mixed with grease, which creeps in from no one knows where, sooner or later destroys the field. It cannot be blown out with a bellows, but most be carefully wiped out with waste—the armature being removed for that purpose. Once a month, or every six weeks, is not too often to cleanse a motor in this manner. The usual nightly inspection of brasses or bearings is too often only superficial, especially as to the clearance of the armature between its pole pieces. It is not enough to see light between the armature and bottom pole-piece. The armature should be turned around and viewed from every position.

In the inspection of controllers it is common practice to dress up the contact points with a file and allow the copper filings to fall where they will; this is frequently the cause of disastrous results. The cylinder should be removed occasionally, about once each month, and the back board thoroughly cleaned from copper and brass filings.

The everyday inspection of grease cups, commutators, tightening of bolts, etc., need not be more than mentioned here, because all inspectors know that swift retribution follows any neglect of these common duties. As to the number of cars which it is advisable to place under each inspector's care, practice will vary; but from six to ten of the old double reduction to three times that number of single reduction, is a fair estimate. It can be set down as a maxim, that the annual cost of motor repairs varies inversely as the amount paid for inspection, and inversely as to the quantity of attention and intelligence displayed by inspectors.

The Review of Reviews, the busy man's magazine, as it is called, contains this month besides reviews a number of very interesting articles upon subjects that the recent labor movements here suggested. The article on Coxeyism is accompanied by portraits of the different "Generals" and maps of the routes taken in their march toward Washington. The progress of the world is presented in the usual skillful manner.

LEGAL NOTES.

SUITS AGAINST CHICAGO COMPANIES.

The Chicago Edison Company has brought suit against the Star Electric Light Company, the Empire Electric Light Company, the Chicago Incandescent Light Company and the Co-operative Electric Light Company for infringement of the Edison patents on the incandescent lamp.

SUIT TO ANNUL THE BERLINER PATENT.

The case of the United States of America vs. the American Bell Telephone Company and Emile Berliner to annul the patent granted to Emile Berliner on November 17,1891, was called on June 14 before Judge Carpenter, in the United States Circuit Court, at Boston. The counsel for the United States are Attorney-General, Hon. Richard Olney, U. S. Attorney Sherman Hoar, Causten Brown and ex-Judge Robert S. Taylor. Wm. G. Russell, Chauncy Smith, James J. Storrow, Fred'k P. Fish and W. W. Swan, appear for the defendant. This suit will be watched with a great deal of interest, as it involves one of the most valuable patents held by the American Bell Telephone Company.

THE POLLARD LAMP CASE.

The suit of the Edison Electric Light Company against the Boston Incandescent Lamp Company, asking for an injunction against the latter company to restrain them from manufacturing the "Pollard" lamp, was decided by Judge Colt, of the United States Circuit Court, on the 11th instant, and a decision rendered in favor of the Edison company. The opinion of the court is brief and very explicit. He states in part as follows:

"The defendants' lamp, constructed after the Pollard patent of November 1, 1892, contains all the elements enumerated in this claim, namely, a carbon filament, all-glass receiver from which the air is exhausted, and conductors passing through the glass. The only difference between the two lamps is that the defendants use a film of powdered silver for the conductors passing through the glass, in place of platinum wire, which Edison points out in the specification as the material to be employed, and which is always found in the Edison lamp of commerce. In other respects the lamps are identical. While Edison uses platinum wire, he does not limit himself to this form of conductor in his claim. The language of the claim is "conductors passing through the glass," and therefore on its face the claim covers all kinds of material capable of carrying the electric current. If the claim had been limited to conductors of platinum wire, as the filament is limited to carbon, the case might be different.

"The invention of Edison resides in the carbon filament; the other elements of the combination were old and subordinate, and represents, so to speak, only the environment of the filament. For this reason I do not think the court should seek to restrict the plain meaning of the language of the claim. And there is another reason for giving the claim a broad construction. Edison made an important invention; he produced the first practical incandescent electric lamp; the patent is a pioneer in the sense of the patent law; it may be said that his invention created the art of incandescent electric lighting. Where a valuable invention has been made, the court will uphold that which was really invented, and that which comes within any fair interpretation of the patentee's claim.

"In dealing with a pioneer invention which creates a new art, it hardly seems logical or reasonable to say that, because in the progress of such art some new substance or device has been discovered which can act as a substitue for one of the elements of the patented invention, anyone can appropriate the invention by the employment of such substitute. And further, if equivalency signifies equivalency in the particular combination or invention, it is difficult to point out in this class of cases what known equivalents existed at the date of the patent, for the reason that the combination of elements in which the invention is embodied was first made known by the patentee. The doctrine of equivalents as applied to primary inventions rests upon a a more satisfactory basis by the elimination of the qualification of age or time, and by holding those things to be equivalents which perform the same functions in substantially the same way. The fundamental question is whether the alleged infringer makes use of the essence of the patented invention, not whether he has adopted a known equivalent or made a patentable improvement on the invention. The motion for preliminary injunction is granted."

ARC LIGHTING MACHINERY LITIGATION.

The suit before Judge Grosscup, at Chicago, of the Thomson-Houston Electric Company against the Western Electric Company, for alleged infringement of patents on method of automatically regulating the current in arc lighting apparatus, was argued on June 15th and 16th. The testimony in the case was printed, the depositions having been previously taken. Judge Taylor, of Ft. Wayne, and Fredk. Fish appeared for the complainants, and Messrs. Barton and Brown for the defendant. The argument on each side was limited to six hours. A large amount of electrical machinery had been provided to illustrate the patents in question, but owing to the brief time at the disposal of the attorneys it was not used. The complainant contended that the patent issued to Thomson and Houston covers all means of regulating the current of dynamo electric machines by the automatic shifting of the brushes by a device that responds to changes in the current of the machine.

The defendant holds that the patent is invalid because it was anticipated by the invention of Hiram S. Maxim on a similar apparatus, and that the patent is not for a patentable invention in view of the state of the art. The arguments on each side were very sharp and many points were brought up which involved the theory and operation of electrical machinery. The decision in the suit was reserved and has not as yet been rendered.

Hymeneal.

Mr. E. W. Goldschmidt, one of the most popular of the representatives of the Western Electric Company, was married on June 14 to Miss Maude Kimball, a very prominent and highly accomplished society lady of Champaign, Ill. The wedding ceremony was performed at the Congregational church of that city, the bride and groom leaving immediately after for San Francisco, where they will remain for several months. Mr. Edw. Ellicott, also of the Western Electric Company, was best man. While in the west Mr. Goldschmidt will have charge of the Western Electric Company's business at the California Fair. His many friends will join Electrical Industries in wishing the newly married couple every happiness.

Chas. G. Armstrong, the well known electrical expert, says the newest thing in electrical circles is the recent arrival at his house. It's a girl.

NEW INCORPORATIONS.

Rockledge, Fla.—The Rockledge Railway and Improvement Company with a capital stock of $10,000.

Chicago, Ill.—The Crescent Electric Co., for the manufacture and winding of armatures, etc., with authorized capital stock of $10,000.

Chicago, Ill —The Pratt Telephone Company with capital stock of $200,000.

Portland, Me.—The Van Choate Electric Co., for manufacturing and dealing in electrical apparatus and machinery; $6,000,000.

Bucksport, Me.—Bucksport Light and Power Co., for furnishing electric light and power, $10,000.

Gardner, Mass.—Gardner Electric Railway Co., $50,000.

Water Valley, Miss.—The Water Valley Electric Light and Power Co., with a capital stock of $10,000.

Waterport, N. Y.—The Waterport Electric Light & Power Co., capital $40 000.

Coshocton, Ohio.—The Coshocton Telephone Company, with capital stock of $10,000.

Cleveland, Ohio.—The Cleveland & Akron Electric Railway Company, capital stock, $300,000.

Norwalk, Ohio.—Norwalk Telephone Co. with an authorized capital of $20,000.

Bellevue, Ohio.—The Bellevue Mutual Telephone Company, $12,000.

Little Rock, Ark.—The Little Rock Telephone Company on June 12th with a capital stock $25,000.

Berkeley, Cal.—The Berkeley Electric Lighting Company; $100,000 on June 6th.

Chicago, Ill.—The Economic Electric Engine Company, for the manufacture of electric motors, engines, etc. June 14th; $100,000.

Terre Haute, Ind.—The Terre Haute Electric Railway Company on June 4th; $500,000.

Grand Rapids, Mich.—The Sweet Electric & Manufacturing Co., for the manufacture of machinery and electrical apparatus; $100,000.

Monroe, Mich.—The Harrison Telephone Co.; $250,000.

Grand Rapids, Mich.—The Michigan Harrison Telephone Construction Company on June 12th; $50,000.

Norwalk, Ohio.—The Ohio Harrison Telephone Construction Company on June 6th, $20,000.

Bradford, Pa.—The Bradford Electric Railway Company with authorized capital $100,000; on June 7th.

Honesdale, Penn.—The Honesdale Electric Railway Co. with capital stock of $100,000.

Little Rock, Ark.—The Suburban Electric Light & Power Company with authorized capital of $50,000.

San Francisco, Cal.—New Electric Power & Light Co., with capital stock of $10,000,000.

Chicago, Ill.—The Groff Telephone Co. for the manufacture of magnetic and electric telephones with capital stock of $1,000,000.

Jersey City, N. J.—The Poppowitsch Electric Co. for the manufacture of electric batteries, etc., capital $100,000.

Camden, N. J.—The Mutual Automatic Telephone Co. for the construction and operation of electric telephones; $200,000.

Cincinnati, Ohio.—The Electric Telephone Construction Company, $10,000.

Cleveland, Ohio.—The Union Electric Co. for the manufacture of electrical and mechanical apparatus, $25,000.

Ft. Wayne, Ind.—The Ft. Wayne Electric Corporation; capital stock, $500,000.

Chicago, Ill.—International Telephone Construction Company on June 5th with $200,000 capital stock.

Chicago, Ill.—The McDermid Manufacturing Co., for the manufacture of annunciators, electric specialties, etc., June 9, $5,000.

Rumford Falls, Me.—The Electro Chemical Company, chemical, electrical and general manufacturing. June 1st, $800,000.

St. Louis, Mo.—The Farmer Electric Co., for the manufacture of electrical devices, etc. June 2d, $60,000.

Pittsburg, Pa.—East Pittsburg Telephone Company, capital $5,000.

Lampasas, Texas.—Lampasas Water, Ice & Electric Company, for furnishing electric light, water and ice. June 5th, $30,000.

Goshen, Ind.—The Indiana Electric Railway Co., $25,000.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Shelbyville, Ky.—The Shelbyville Water & Light Company has recently been organized. G. C. Morgan is manager.

Canton, Miss.—The Canton Water Works & Electric Light Company hopes to have its plant completed before the close of this year. N. C. Orrick is secretary.

Fairmont, Minn.—St. John & Co. contemplate the addition of an arc dynamo.

Northfield, Minn.—The Northfield Light, Heat & Power Company are planning to add street and residence lighting.

Hannibal, Mo.—The city proposes to add 12 arc lamps to its plant. Address the city clerk.

Maryville, Mo.—The Maryville Electric Light & Power Company will add an engine and an arc dynamo. J.W. Springer is purchasing agent.

Berkeley, Cal.—The Berkeley Electric Lighting Company will add a 250-horse power engine and a 100-horse power generator. It is also in the market for railway equipment. Five cars will be needed.

Geneseo, N. Y.—The Geneseo Gas Light Company hopes to have its plant completed and in operation by October 1 next. Theo. F. Olmstead is purchasing agent.

Warrensburgh, N. Y.—The Warrensburgh Electric Light Works commenced operations in January last. Its owner, Mr. John G. Smith, proposes to extend its lines to Lake George, six miles distant.

White Plains, N. Y.—The Citizens' Gas & Electric Company will add an arc dynamo, boiler and engine. R. E. Slade is purchasing agent.

Slater, Mo.—The city will add a water works system to its present light plant. R. T. Brightwell is mayor.

Whitehall, N. Y.—The Whitehall Electric Light & Power Company contemplates the addition of a new boiler and engine. The Whitehall Gas Light Company is looking for a good 200-horse power boiler and engine, second hand. T. S. McLachlin is president and purchasing agent.

Cincinnati, O.—The Cincinnati Edison Electric Company contemplates the erection of an arc plant of 2,000-light capacity for city lighting. Alfred Knight is purchasing agent.

Gallatzin, Pa.—The Gallatzin Electric Light Company is extending its line to Cresson Springs, four miles distant.

Hanover, Pa.—The Hanover Light, Heat & Power Company will extend its arc circuit and add 12 lights.

Huntington, Pa.—The Huntington Electric Light Company is installing a 650-light alternating machine, and hopes to have it ready for business by July next.

Richland Centre, Wis.—The Richland Centre Electric Company may add considerable residence lighting. G. H. Strang, owner.

Mexico, N. Y.—The Mexico Electric Company is now installing a new engine and boiler, shafting, pulleys, clutch couplings, etc. E. L. Huntington is purchasing agent.

New Iberia, La.—The Pharr & White Electric Light & Power Company wants a second-hand 800 or 1,000 light alternating machine. An extension of its lines is also contemplated. B. R. White is purchasing agent.

St. Johns, Mich.—The St. Johns Electric Light & Heat Company will erect a new station and largely increase its power capacity. It is in the market for good second-hand engines. G. A. Steele is purchasing agent.

Luverne, Minn.—The city will add to its plant two 100 horse-power boiler. W. F. Kendall is purchasing agent.

Joplin, Mo.—The Southwestern Electric Light & Water Power Company wants quotations on a 500 volt motor and ceiling fans.

Palmyra, Mo.—The Palmyra Light & Water Company will add arc and incandescent dynamos.

Jamestown, N. Y.—The capacity of the municipal plant will be doubled as soon as possible. James Hanson is purchasing agent.

Antrim, N. H.—The Goodell Company has its new light and power plant at Bennington well under way and will soon be in operation. It will furnish all lights required for the villages of Antrim and Bennington.

JORDAN, N. Y.—The Jordan Electric Light & Power Company proposes to change its power from water to steam. N. T. Wilcox is purchasing agent.

LYONS, N. Y.—The Lyons Electric Light & Power Company will increase its alternating dynamo capacity. J. W. Van Etten is purchasing agent.

MATTEAWAN, N. Y.—The Carroll Electric Company is now adding lagely to its whole equipment.

NEW YORK, N. Y.—The North River Electric Light & Power Company will add two new boilers to its equipment. Edward A. Maher, jr., is purchasing agent.

CLINTON, IOWA.—The Clinton Gas Light & Coke Company will add a new boiler and condensers. S. M. Highlands is purchasing agent.

STUART, IA.—A dynamo is to be added to the equipment of the City Light & Power plant. George M. Cox is purchasing agent.

MARSHALLTOWN, IA.—The Marshalltown Light, Power & Railway Company will add two good second-hand trailers. It offers for sale 20 year gold bonds, bearing 6 per cent interest. Jones and Hovey are purchasing agents.

EUREKA, KANSAS.—Mr. W. R. Hardy, owner of Eureka Electric Light plant, contemplates the addition of an alternating machine.

FRANKFORT, KY.—The Capital Gas & Electric Light Company will add a 60-light arc machine. E. C. Hathaway is purchasing agent.

BALTIMORE, MD.—The Brush Electric Light plant, which was destroyed by fire last fall, is now being rebuilt. H. C. Tudor is purchasing agent.

BOSTON, MASS.—The Cohassett Electric Company contemplate adding a new boiler. A. A. Lawrence, 633 Washington St., is president and purchasing agent.

FALL RIVER, MASS.—The Edison Electric Illuminating Company is erecting a new station, and installing a new boiler, engine and generators. Albert F. Dow is purchasing agent.

NORTHAMPTOM, MASS.—The Northampton Electric Lighting Company is building an extension to its plant. It will be finished by August next.

BOONE, IA.—The Boone Electric Street Railway & Light Company is contemplating the addition of a 500 horse-power engine. S. T. Stanfield is secretary and manager.

ALBERT LEA, MINN.—The Albert Lea Electric Company will enlarge its station, and add an engine, dynamo and boilers. C. G. Edwards is purchasing agent.

ALEXANDRIA, MINN.—The village plant is to have its equipment increased by the adition of an incandescent dynamo and a pump C. A. Johnson is chief engineer.

ST. PAUL, MINN.—The Midway Electric Light Company was recently incorporated. G. F. Downing is secretary.

FALLS CITY, NEB.—The Falls City Electric Light plant (owned by the city), will have added to its equipment a new engine and two 750-light alternating dynamos. F. E. Farrington is purchasing agent.

PRINCETON, N. J.—C. S. Robinson, proprietor of Princeton Electric works will add an alternating machine, a boiler and arc and incandescent lamps.

BROOKLYN, N. Y.—The Edison Electric Illuminating Company contemplates the addition of 3,500 horse-power engines to provide for extensions of underground system and for ordinary increase of business.

HOOSICK FALLS, N. Y.—The Hoosick Falls Water Power & Light Company is now installing apparatus to furnish power to Hoosick Railway Company. C. B. Story is purchasing agent.

BRAMWELL, W. VA.—The Bluestone Electric Light Company will add an arc dynamo. H. T. Mercus is purchasing agent.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

PITTSBURG, KAN.—The Forest Park Street Railway Company contemplates an extension of its lines to Frontenac, three miles distant. Sam Barratt is purchasing agent.

COVINGTON, KY.—The Cincinnati, Newport & Covington Street Railway Company is now extending its line to Ludlow, Ky.

MIDDLETOWN, N. Y.—The Middletown-Goshen Traction Company is now extending its line to Goshen, N. Y., seven miles distant. It will also construct four miles of road throughout Middletown.

MCKEESPORT, PA.—The McKeesport & Reynoldson Passenger Railway Company is now extending its line, and will add to its steam and generator power.

SAN ANTONIO, TEX.—The San Antonio Rapid Transit Company will double track two miles of its line, and add three motor and four trail cars. B. W. Randall is purchasing agent.

BAY RIDGE, MD.—The Bay Ridge Electric Company will extend its line to Annapolis, Md.

HELENA, MONT.—The Helena Rapid Transit Railroad Company will add one mile to its road.

CHILLICOTHE, O.—The Chillicothe Electric Railway & Lighting Company's plant will probably be sold at receiver's sale within 60 days. A. H. Rentinger is receiver.

DELAWARE, O.—The Delaware Electric Street Railway Company will construct a belt line about one mile in length.

NASHVILLE, TENN.—The plant formerly owned by the Electric Railway & Power Company, is now owned and operated by the Citizens Rapid Transit Company.

ST. JOSEPH, MICH.—The St. Joseph & Lake Shore Street Railway Company proposes to add four and one-half miles of track next year. W. M. Garver is purchasing agent.

NEW BOOKS.

Electricity One Hundred Years Ago and Today, with copious notes and extracts, by Edwin J. Houston, New York, 1894. The W. J. Johnston Co., Ltd., 200 pages; postpaid, $1.00.

This book contains the text of a lecture on the above subject, delivered before the electrical section of the Brooklyn Institute, to which the author has added, in preparing it for publication, many notes, extracts and references, which will be found very useful by anyone who wishes to study the subject further. In a book of this size it is possible to touch but briefly the various events in the history of the science. The author traces the history of electricity down to the present day, and in doing so he gives, as the result of his researches, several dates and discoveries to which the science is indebted that have not before been acknowledged. The author gives brief explanations of the discoveries of the different persons, which makes the work much more interesting than a mere statement of the discoveries.

The Practical Application of Dynamo Electrical Machinery by Carl K. MacFadden and Wm. D. Ray, Chicago, 1894. Date & Ruggles. Illustrated, 170 pages; price, postpaid, $1.00.

Many books have been written on this subject for the non-technical reader, but few possess the merit that this volume has for completeness and the comprehensive manner in which the subject is presented. The authors have each had not only a special theoretical training, but an extended practical experience, which has given them a thorough and complete knowledge of the subject. The difficulty which is usually experienced in excluding the mathematical formulæ and technical phraseology which is so closely associated with the study of electricity, seems to have been fully overcome. The terms and data necessary to the study of the book are stated and illustrated in chapter 1, which is but eight pages long. The terms are stated and compared with quantities with which the reader is familiar, making them both easy to remember and easy to understand. This method is quite different from the encyclopedia sort of a way in which it is often done. Magnetism and induction, the theory of dynamos and current distribution are some of the subjects treated in the earlier part of the book. Each is treated concisely and briefly, but at sufficient length to cover the subject as far as necessary to understand the practical questions. This method of treatment admits of the subject being covered in this volume of 170 pages. The chapters devoted to the alternating current and alternating current apparatus are very clearly written, and the illustrations greatly aid the text. This part of the book will be found of great interest by all who desire a knowledge of this department of electricity. The transformer, its theory, construction and operation are explained and illustrated by cuts. The single phase and multiphase currents are skillfully illustrated. The different types of dynamos receive attention, and for those engaged in electrical pursuits a chapter is given to causes of trouble in dynamos—their remedy and prevention. The standard makes of electrical apparatus and instruments receive attention in the closing chapters of the book. The volume is bound in flexible cloth covers, and is of a convenient size to handle or to carry for reference. The 170 pages are well filled, and show most careful work on the part of the authors.

FINANCIAL.

The past month has witnessed no special activity in electrical circles. A number of important contracts have been let, among which is the contract for the electrical equipment of the Metropolitan elevated road, Chicago, amounting to about $225,000. Small contracts have been more numerous. Among dealers in supplies and apparatus a fair demand is reported. The most important event among the manufacturing companies during the month was the organization of the Ft. Wayne Electric Corporation, which purchased the assets of the Ft. Wayne Electric Co., from the receiver. The Ft. Wayne stockholders of the above company believing that the General Electric Company which controlled a majority of the stock, intended to close the works of the company, determined upon a move that would checkmate any such design. On June 6th, Mr. R. T. McDonald applied for a receiver for the Ft. Wayne Electric Company, which was granted. At the same time Mr. McDonald organized the Ft. Wayne Electric Corporation which purchased from the receivers the assets of the Ft. Wayne Electric Co. The General company, in order to secure some claims, got out attachments for the property of the company but before they were served the property had been transferred. This undoubtedly completely separates the Ft. Wayne and General companies so that the new Ft. Wayne corporation will be an independent factor in the electrical field.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING May 25.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	213
“ “ “	Bds. 1893.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co... ...	Com.	14,000,000	100	....	....	85
Commercial Cable Co	Com.	7,716,000	100	....	....	120
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	F. Q.	115
“ “ “ ...	C. Bds. 1898.	71,000	100	6	M. & S.	.....
“ “ “	C. Bds. 1901.	586,500	100	6	M. & N.	.....
“ “ Brooklyn..	Com.	2,500,000	100	....	Q. F.	85
“ “ “ ..	1st. 1940.	500,000	100	5	A. & O.	100
“ “ “ ..	Regis.	....	100	5	A. & O.	.....
“ “ Chicago...	Com.	3,000,000	...	8	Q. F.	135
“ “ “		2,500,000	....	....	....	.....
“ “ New York.	Com.	7,938,000	100	....	Q. F.	100
“ “ “	1st 1910.	2,562,000	100	5	M. & S.	107
“ “ Phila......	Com.	1,473,000	100	....	....	120½
“ “ “		... .	....	5	....	.....
Fort Wayne Elec. Co...... ...	Com.	4,000,000	25	....	....	.....
General Electric Company.	Com.	30,457,000	100	....	......	36½
“ “	Prf'd.	4,251,900	100	....	....	70
“ “	Deb. 1922.	10,000,000	100	5	J.-D.	70
Gold & Stock Tel. Co............	Com.	5,000,000	100	....	Q. J.	... .
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	90
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	..	....	.....
Thomson-Houston Elec. Co . .	Series D.	120,000	10	...	....	5⅜
Thom'n-Houst'n Intern. Elec. Co.	Com.	600,000	100	...	....	.....
“ “ “ “	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co....	Com.	1,000,000	100	....	....	.....
“ “ “	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q J.	83
“ “	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	36½
“ “ “	1st Pf. Cum.	3,755,700	50	7	....	51⅛
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R..............	Com.	6,000,000	10	....	Q.-J.	170
“ “	1st Bds. 1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	....	Oct. 1.	.....
“ “ “ ..	1st Bds. 1909	300,000	100	5	J. & J.	.....
“ “ “ ..	Certf. 1894.	300,000	100	6	J. & J.	.....
BUFFALO—						
Buffalo St. Railway..............	Com.	5,370,500	100	5	....	.....
“ “	Bds. 1931.	5,000,000	100	....	F. & A.	.....
BOSTON—						
West End St. Railway...........	Com.	9,085,000	50	..	J. & J.	47
“ “	Prf'd.	6,400,000	50	5	J. & J.	77
“ “	Bds. 1902.	3,000,000	100	....	M. & N.	100⅛
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	.....
“ “	Prf'd.	1,000,000	100	5	A. & O.	.....
“ “	1st Bds. 1930	6,000,000	100	....	J. & J.	.....
NEWARK, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	....	....	27⅜
“ “	Bds. 1930.	6,000,000	100	5	J. & J.	84⅛
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	155
“ “	Bds.	2,000,000	100	...	....	.....
PITTSBURGH—						
Duquesne Traction Co........ ...	Com.	3,000,000	50	...	....	26
“ “	Bds. 1930.	1,500,000	100	5	J. & J.	103
Fed. St. & Pleas. Val. R. R.......	Com.	1,400,000	50	....	J. & J.	20
“ “ “ “ “	Bds. 1919.	1,250,000	100	5	J. & J.	102
Pittsb'gh, Aleg. & Man. R. R.....	Com.	3,000,000	50	....		41
“ “ “	Bds. 1931.	1,500,000	100	5	J. & J.	103¾
Pittsburgh & Birming. R. R.....	Com.	3,000,000	25	....	......	12½
“ “ “	Bds. 1929.	1,500,000	100	5	M. & N.	95
ROCHESTER—						
Rochester Railway Company....	Com.	5,000,000	100	...	....	67
“ “ “	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway..............	Com.	2,500,000	100	....	Q.-J.	89
“ “	Bds. 1910.	1,500,000	100	5	J. & J.	102
St. Louis & Suburban............	Com.	2,500,000	400	....	....	12
Union Depot Railway...........	Com.	1,200,000	100	....	....	150
“ “ “	Bds. 1910.	1,000,000	100	6	A. & O.	102⅛

TRADE PUBLICATIONS.

We are in receipt of Chas. E. Gregory's 1894 edition of his vest pocket telephone directory and addresses of the electrical and allied trades of Chicago. The book is handsomely bound in russia, on fine linen paper, and its makeup reflects great credit upon its compiler. Country purchasers of Chicago material should have one for their convenience, and they are free to all such applicants. He has added a list of hotels and amusements, thus widening its scope and increasing its value.

"A few reasons why the Harrison telephones are the best" are presented in a little pamphlet issued by the Harrison International Telephone Company. It contains a large number of letters from business and professional men, who are users of the Harrison telephone, which are complimentary to the telephone. The letters come from almost every direction, showing that the telephone is in use in every part of the country. Considerable information is given regarding the telephone, terms of sale and lease, exchange systems and private lines. The pamphlet is well gotten up and printed in an attractive style.

A small pamphlet issued by the National Water Tube Boiler Co. of New Brunswick, N. J., contains many facts regarding the National boilers. It calls attention to the conditions under which complete combustion is secured and the following facts in the construction of the National boiler and furnace: "The large furnace area permits the perfect chemical combination of the constituents of the fuel under conditions that insure a high temperature at every point. The thin tubes making up the heating surface of the boiler are placed directly within this combustion chamber. Nearly all the water is brought in contact with the tubes and it rapidly absorbs heat from the highly heated gases. As soon as the water is heated, a steady motion begins, the heated portion moving away to make place for other particles to become heated. A complete and thorough circulation of the water being thus secured, the whole volume of contained water is brought to the point where it will most rapidly absorb the heat of the gases." Many special points of construction are pointed out and the many important power stations where the National boilers are in use.

The Standard system of dynamo electric machinery and accessories is presented in an excellent manner in the handsome new catalogue just published by the Standard Electric Company of Chicago. Complete equipments are shown for arc and incandescent lighting and power plants. Neatly executed plates show the designs of apparatus and the details of the different parts. Sufficient explanation of the various apparatus accompany the plates to make clear any complicated features. Everything is clearly stated and will attract the attention of practical men more than the mass of verbiage that often fills catalogues of this kind. The catalogue reflects great credit on its compilers by its excellence in every respect. It is printed on glazed book paper and bound in flexible covers. Considerable space is given to switch board designing and outlines of switch boards, showing the position of the instruments, switches, wiring, etc., which makes the catalogue of value to everyone interested in the subject. The tables of dimensions with outlines of the different machines is a feature that will be highly appreciated. The Standard company has gained and maintained a prominent position among the manufacturers of electrical apparatus by the high grade of goods it has had on the market. The line of apparatus here presented, which includes many new machines, would indicate that the business of the company is to be greatly extended They are all of modern design and show the latest practices in their construction. This volume might well be preserved as indicating the state of the art at this time.

A volume of one hundred pages entitled "A Few Plain Facts Concerning Water Tube Boilers," has been issued by Abendroth & Root Manfacturing Co., of New York. Nearly every phase of the boiler question is considered, and numerous cuts aid the text and facilitate the presentation of the subject. As an introduction the history of the Root boiler is slightly touched upon. The changes that were made in its construction and the reasons that led the builders to make the changes, bring out many interesting facts in boiler construction. By a comparison of the first forms and the latest improved type of Root boiler the main principles of the water tube boiler are apparent. The baffle walls are present in both, the circulation of the water is provided by the connec tion of the tubes. In the old style the headers were connected by triangular shaped boxes having three openings, which were received into corresponding openings in the header boxes, while in the improved boiler the connecting box takes more the shape of a connecting pipe. In the later types improvement is everywhere noticeable in the smallest detail, being required by the high pressures of modern practice. The improved Root boiler is thoroughly described and illustrations of boiler construction such as the plant of Root boilers at the World's Fair, are scattered through the pages. The methods of repair, or replacing parts, cleaning, etc., are shown by well-executed cuts. The action and operation of the different parts of the boiler when in use is described." Illustrating and defining the co-efficient of expansion, "definition and illustration of the modulus of elasticity," and "definitions of radiant heat," are some of the subjects treated. A considerable space is given toward the close of the pamphlet to the cleaning of boilers, and the facilities for cleaning the Root boiler is very clearly shown by numerous cuts in which the cleaning of every part of the boiler is illustrated. The pamplet will be found of interest to every steam user on account of the valuable information it contains.

From the Creaghead Engineering Company, of Cincinnati, comes a very neatly gotten up catalogue of electric railway overhead parts. Everything required in the construction and repair of the overhead work of the electric railway is here illustrated or listed. The attention given by manufacturers and dealers in electrical apparatus to catalogues shows their value to the trade. The present facilities for producing cuts illustrating the special piece of apparatus, has made them an important feature of almost every catalogue issued. A single cut is often of greater value in bringing an article to the attention of the user than several pages of descriptive matter. The numerous cuts of line material presented in this catalogue add greatly to its attractiveness. Insulators, pull overs, cross overs, frogs, etc., are shown in numerous styles and the accompanying descriptive matter points out the special features and methods of construction. The line of material is most complete and of a high order of manufacture. Special attention is called to the construction of the insulators giving great strength and good insulation. Wire for trolleys, for feeders, for span wires, etc., together with lighting arresters, station switches, arc lamps pulleys and devices for suspending the are lamp over streets where the trolley is used, are some of the supplies listed. Cipher code and index, which is short and sufficiently complete for all purposes, completes the catalogue.

The latest edition of "Lundell Motors and Dynamos," issued by the Interior Conduit & Insulation Company, contains a large amount of information concerning the smaller Lundell motors, such as are designed to operate sewing machines, organs, dental outfits, and tools of every kind. The slow speed power motors are wound for 110 volts and four volt battery circuits. They run noiselessly with self-oiling and aligning bearings. Illustrations executed with much skill show the motors of the different styles with base that may be fastened to the floor, wall or ceiling. The cuts show the general appearance of the motor as well as the details of the most important parts. The iron clad construction is especially noticeable, indicating durability and keeping the interior working parts free from dust or water, should such be encountered. Exhaust fans, ventilating fans and fans for every purpose, are shown. The fans and motors for 1894 have many improved features. The brush holders are simple and most efficient. These fan motors are shown in the styles and sizes for the desk with larger or smaller fans and with variable speeds of 1,800, 1,400 and 1,100 revolutions per minute at 110 volts. They are shown with Japanned finish, polished brass and nickel plated. Considerable attention is given to battery fan outfits, which are becoming more and more popular. Eight volts and five amperes are required for these outfits. The line of fan motors for special purposes is most complete. The bracket and suspended fan outfits are easily adjusted to change the direction of the breeze. The catalogue closes with a description of the direct connected Lundell ceiling fan, which is a 1894 model. The outfit as shown has no belting, no shafting and the switch is operated by the cord and tassel which hangs from the lowest point of the motor. It is one of the handsomest catalogues of the season, well designed and printed. The paper is of excellent selection and the cuts and illustrations very clear and well executed.

PERSONAL.

Mr. S. H. Short and Mr. J. M. Atkinson, of the Walker Manufacturing Company of Cleveland, were in Chicago for a short time last month.

Mr. Aleck H. Lewis has accepted the Cincinnati agency of the Abendroth & Root Mfg. Co. Mr. Lewis is well known in the electrical field and has the record of a most successful saleman.

Mr. A. L. Daniels, formerly with the Miamisburg Electric Company, is now general manager of the Akron Marble Company of Akron, O. Mr. Daniels recently paid Chicago a visit in the interests of his company.

Mr. E. E. Wood, secretary of the Electrical Industries Publishing Company, and well known to the electrical fraternity of the east as manager of the New York office, was married on June 27th to Miss Anna Teresa Martin of New York.

Mr. Thomas A. Edison sustained last week what has proved a severe accident although at the time it received little attention. While sitting on a porch at Ogden, N. J., his chair gave way, throwing him heavily on his back. Mr. Edison picked himself up and said he felt no pain or inconvenience. The next day, however, upon returning home he became ill and has since been unable to leave the house.

BUSINESS NOTES.

The General Electric Company has transferred its Washington office to 227 E. German street, Baltimore, Md. The transfer took place on the 21st instant.

The Hart & Hegeman Manufacturing Company of Hartford, Conn., has just removed its western office to 1644 Monadnock Block, Chicago. This branch of the company is in charge of Mr. Geo. S. Searing, who carefully looks after the best interests of his company in the western territory.

Geo. L. Colgate Company, 136 Liberty street, New York, has purchased of Mr. W. A. Vail his interest in the well-known "swinging ball lighting arrester" which is now used in many stations, and has a good record wherever it has been tried. It has been improved, the price lowered, and is now before the trade better than ever.

The Simplex Electric Company has opened a Chicago office at 1137 and 1138 Monadnock Block. A stock sufficient to supply all demands will be carried in Chicago. Mr. H. R. Hixson, who has many acquaintances among the trade and has had an extended experience in handling insulated wire, will have charge of the office.

William L. Walker & Co., 178 Summer street, Boston, Mass., has recently engaged in the business of dealing in electrical supplies and apparatus. The members of the firm are not unfamiliar with the business, having been connected for years with the old companies. A very prosperous business career is promised them.

The Chicago Rawhide Manufacturing Company, Chicago, has just received word that a gold medal has been awarded for the superior merit of its goods by the Irish Industrial Exhibition, Belfast, Ireland. Business with this company still continues to be fairly brisk, shipments being made constantly to all parts of this country and England.

The General Electric Company, a contemporary says, has received recently contracts as follows: Equipment of Allegheny Traction Company's line, including two 27 horse-power generators and 30 motors; 930 motors for the Electric Traction, People's Traction and Hestonville lines of Philadelphia, and 450 motors for the Queen Company and suburban line of Brooklyn.

E. P. Roberts & Co., Cleveland, Ohio, has added to its force Mr. W. B. Stewart, who becomes a partner in the firm. Mr. Stewart has had an extended experience in electrical and mechanical work covering some 29 years. The firm has a large amount of expert and engineering work on hand, and the services of Mr. Stewart will be valuable to their clients as well as to the firm.

The Thompson Electric Welding Company, Lynn, Mass., has added the Sauer gas engine to its list of manufactures, having acquired the patent rights for the United States. The engine will be made in 2, 4, 8 and 12 horse power. Electric plants for isolated lighting will be furnished with these engines. It has been shown that with these gas engines small plants may be operated at a very low figure.

Munderloh & Co., Montreal, has been appointed sole Canadian agent for the Allgemeine Elektricitaets-Gesellschaft of Berlin, Germany. The firm of Munderloh & Co. is well and favorably known in the commercial world of Canada, and the line of electrical goods which it will now handle should give it a prominent place in the electrical field. The apparatus of this German company have been sold in almost every country. The list of goods includes electric railway equipments, power plants, lighting plants, arc and incandescent lamps, dynamos, motors, insulated wires, etc.

Mr. J. Holt Gates, Monadnock block, Chicago, is the western agent of the Card Electric Company which has just placed before the trade the electric railway equipment illustrated in this issue.

The Clonbrock Steam Boiler Works, Brooklyn, N. Y., has recently closed a contract with the Edison Electric Illuminating Company of Brooklyn, N. Y., for 4,000 horse-power of Climax boilers for the First district station on Pearl St., Brooklyn. This contract is important from the fact that the Climax boilers were selected from among many competitors by a company which has in its employ some of the best engineers with long periods of experience.

The Union Brass Manufacturing Co., 123-127 Ontario street, Chicago, is the name of the company formed by the recent consolidation of the Chicago Nickel Works, the Reimann Company and the Mosher Electric Company, of Chicago. The president of the consolidated company is Mr. Adolph Weinberg, who has been the treasurer of the Adams & Westlake Company. The company will manufacture a general line of hardware specialties and electric lamps.

The Belknap Motor Company, Portland, Me., has been very successful in the sale of its woven wire brushes which are now used in a large number of the central stations of the country. The combination of woven copper wire and graphite seems to have met the requirements both as regards conductivity and the preservation of the commutator. The company makes not only brushes in sizes up to two and one-half inches wide, but also special brushes for machines over 600 volts.

F. M. Hicks & Company, 68 and 70 So. Canal St., has sold recently Raymond gas engines as follows: Mickle & Pitzel 767 So. Halsted St., one 25-horse power; U. S. Arsenal, Indianapolis, one 50-horse power to operate a 500 light dynamo; Chicago, one 50-horse power engine; for grain elevators at Fouster, Indiana, one 50-horse power and one 40-horse power engine and to La Fayette, Ind., one 30 horse power gas engine. These engines are having a remarkable sale, especially for isolated electric lighting plants for which they are especially adapted.

The Higham Electric Company, 164 High street, Boston, Mass., places before the trade an incandescent arc lamp for which a number of valuable features are claimed. It is claimed that 92 per cent of the total comsumption of watts are used in the arc. Solid carbons are successfully used with the best results and a total illumination 30 per cent in favor of the Higham lamp. The mechanism of the lamp is said to be simple, with few parts and giving perfect regulation. It does not hiss and there is no variation in candle power.

The Electrical & Mechanical Engineering & Trading Co., 39 Cortlandt street, New York, is the consulting and supervising engineer of the Poughkeepsie City & Wappinger's Falls Electric Railway Co. This system when completed will be quite extensive. The equipment has been secured and under the supervision of the above company is being rapidly installed. Among contracts which the company has on hand is the construction and equipment of the Hoosick Railway Company's road, the Lighting station at Rumsen Neck, N. J., telephone systems, and various electrical construction work.

The Electric Appliance Company, 242 Madison street, Chicago, reports the sales of Allen soldering stick for one day last week amounted to 500 sticks, most of the orders being in small lots of a dozen or so. The company has placed them on sale with the leading supply dealers of the country, who will have little trouble in introducing this article, which has already become a favorite with the wiremen. One of its great advantages is the convenience with which it can be carried, which is especially appreciated by wiremen. The company recently received a letter from an enthusiastic wireman who said he could solder anything when he used the Allen stick. The stock of fan motors is kept up by shipments from the factory, so that all wants can be at once supplied. The warm weather of the past few weeks has created a large demand for these breeze producers.

The Metropolitan Electric Company, Chicago, reports that notwithstanding the hot weather its business has been very much on the increase, the demand being unusually large for all of its specialties. Among the specialties P. & B. paint is one of the leaders. Of the recent agencies for the West that the company has secured is the Ruberoid flexible tubing and rods. This tubing is at present meeting with a large sale for buildings, no joints or couplings being required in putting it in. The Kester arc lamp, which is made for direct and alternating currents, is also meeting with a large sale. I. X. L. weather proof wire is having a steady demand and is considered one of the company's staple leaders. The recent hot weather has made a great heavy demand for the Dayton ceiling fan and the Crocker-Wheeler desk and bracket fan, leading specialties in this line. Among other things, the company is introducing the Kester conserver, an article new in the West, but meeting with great success owing to its superior qualities.

The Joseph Dixon Crucible Co., Jersey City, N. J., has given particular attention to the manufacture of waterproof graphite grease and graphite lubricants of all kinds. The standard products of this company have been most satisfactory in use. Some interesting tests were made a short time ago at the Brooklyn navy yards under the direction of Robert Grimshaw and Lieut. John A. Bell, of the equipment bureau U. S. Navy, for the purpose of determining the percentage of power wasted by unlubricated blocks. The results of these tests showed a difference in the power required when dirty bearings and bearings on which graphite lubricants were used of 60 per cent, and between clean dry bearings of 33 per cent.

Mr. George Cutter, the Rookery, Chicago, has taken the exclusive western agency for the wires of the Chicago Electric Wire Company. He will carry a complete stock of rubber covered wires, plain, braided and lead covered and will make a specialty of lead-covered wires in small sizes. A large stock of flexible interior conduit will be carried. Mr. Cutter recently secured the western agency of the Interior Telephone Company of New York, and will now be able to supply complete telephone equipments. These new agencies, in connection with the extensive lines of electrical supplies and specialties for which Mr. Cutter is well known, will add greatly to his list of customers among the users of electrical goods. The Chicago electric wire is already a standard wire and needs no introduction to the western trade. Were this not a fact, that it is handled by George Cutter would be sufficient evidence of its high quality.

The Electric Heat Alarm Company, 145 High St., South Boston, Mass., has leased a larger factory for a term of years and takes possession this month. The present equipment of the factory will be greatly increased, giving the company the facilities for the manufacture of its goods at the lowest possible prices. Mr. F. S. Palmer, the manager of the company, says that the business has increased very rapidly recently and that the statistics of fire losses, which show that the loss by fire for the six months ending July 1st, 1894, are having a tendency to make the manufacturers and builders look around for protection and will also have a tendency to cause the insurance people to raise the rates of insurance. The best protected buildings always get the lower rates. The systems of heat alarm, which have been brought out by this company and improved from time have proved most satisfactory and the many friends of the company will be pleased to learn of its continued prosperity.

Andrews & Johnson, 247 and 249 S. Jefferson St., Chicago are very busy at this time filling orders for their well-known ventilating outfits, consisting of ventilating fans and general ventilating apparatus, one of the leading specialties of this popular firm. A year ago the firm, owing to rapidly increasing business, were compelled to remove to their present quarters, where they have fitted up fine offices and have every facility for manufacturing all kinds of sheetiron work, ventilating machinery, etc. The floor space which they occupy is something over 12,000 square feet. The firm report a very satisfactory increase in business from the fact that up to the first of June of the present year it was considerably greater than that of a year ago covering the same period. Among recent contracts, they are just finishing a contract for the new Stock Exchange building, Chicago, where they are putting in three exhaust blowers driven by electric motors, two of which are 25 horse-power each and the other one 10 horse-power. The contract includes the entire galvanized iron work in connection with the heating and ventilating plant. At present the firm are extremely busy in filling orders for ventilating business, most of the outfits being operated by electric motors, although they are selling a large number of their steam engines, which are especially adapted for this service. In addition to the contracts already mentioned they have a contract for heating and ventilating the new Criminal Court building with their combination fan and engines.

The Chas. E. Gregory Company, Chicago, Ill., reports the following sales for June: One 50 light D. 12 T. H. arc dynamo to P. Norcross, Janesville, Wis.; two 30 light and one 20 light Sperry dynamos to B. Marks & Son, Chicago; one 6 light Sperry arc to Jas. I. Ayer, New York, N. Y.; one 3 light Sperry arc to J. P. Karr, Reynolds, Ind.; one 500 light 1,000 volt, to T. H. alternator to P. Milroy, Hopkinton, Ia.; two 180 ampere Westinghouse generators to International and Wells Packing Company; one 180 ampere Westinghouse generators to W. T. Osborne, Kansas City, Mo.; one 210 light Edison generator to G. B. Weise & Son, Chicago; one 25 horse-power D. R. Westinghouse motor to O. H. Parker, Anniston, Ala.; three 3 horse-power Westinghouse motors to Andrews & Johnson, Chicago; one 5 horse-power T. H. motor to Andrews & Johnson, Chicago; one 2 horse-power Sperry series motors to John Raber, Chicago; one 3 K. W. 500 volt Edison motor to M. Schu, Aurora, Ill.; one 3 K. W. Edison to Chicago Braid and Embroidery Company, Chicago; one 1 horse-power Crocker-Wheeler 500 volt motor to Four Lakes Light and Power Company, Madison, Wis.; one 1 horse-power C. & C. 110 volt motor to A. L. Daniels, Marion, Ia; one 1 horse-power Jenney 500 volt motor to E. J. Davis, Aurora, Ill.; one 1 horse-power Rockford 110 volt motor to Geo. Wolf, Chicago; one 1 horse-power Detroit motor to Baltimore Cafe, Chicago; one 1 horse-power Crocker-Wheeler motor to Lyon & Healy, Chicago; one 1 horse-power Edison motor to Goltz & Sinclair, Milwaukee, Wis.; 14 Edison arc lamps to W. T. Osborne & Co., Kansas City, Mo.; 6 Knowles D. C. arc lamps to Kuh, Nathan & Fischer, Chicago; 6 Edison arc lamps to B. F. Harris, jr., Champaign, Ill.; 15 Edison arc lamps to M. Eichberg, Chicago, and a total sale of 147 fan motors of all kinds. Mr. Gregory reports that the demand for apparatus is far in excess of the supply, and that purchases of dynamos and motors were made in Boston, Philadelphia and San Francisco during the month for their stock.

ELECTRICAL INDUSTRIES.

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The City of Sandwich Municipal Lighting Plant.

Sandwich, Ill., has now in operation an electric lighting system which enjoys the distinction of being the first of its kind installed. The plant has been in operation about a month and is giving perfect satisfaction. The starting of the plant was considerably delayed on account of the scarcity of coal which was felt by all stations during the strike of the bituminous coal miners. The city had for several years been lighted entirely by oil lamps which were considered insufficient and unworthy of a progressive city. With the citizens in favor of it, it was not difficult for the mayor and city council to secure a system of electric lighting but to select a system that was the best suited to the requirements of the city was more difficult. The times were most favorable for purchasing the equipment; contracts few, competition great and plenty of material in stock.

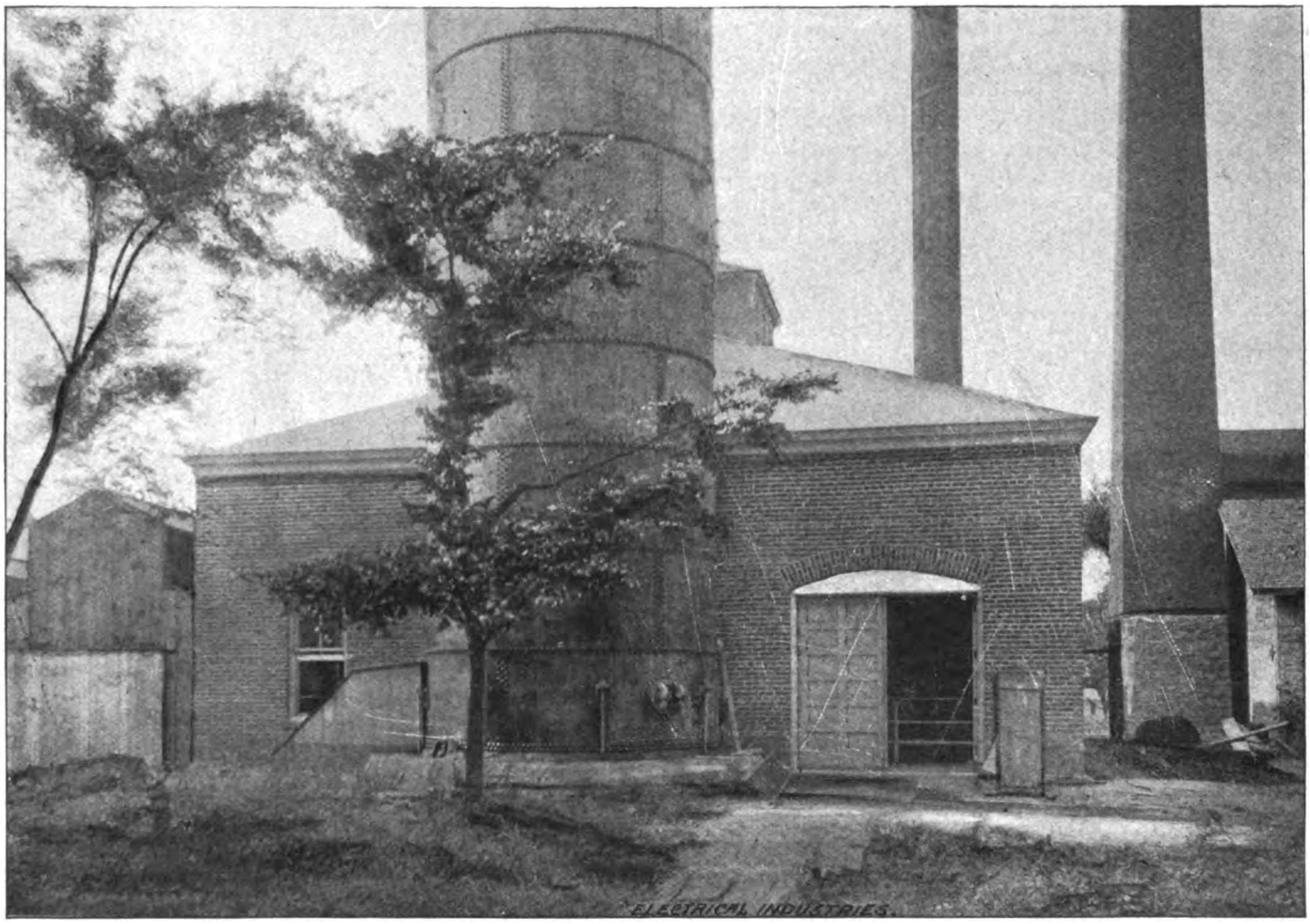

FIG. 1.—THE CITY OF SANDWICH MUNICIPAL LIGHTING PLANT.

Mr. E. W. Graves, the mayor of Sandwich, was most active in the discussion of the different systems advocated. Probably no man learned so much about electricity in so short a time, nor had so much information of a suspicious character thrust upon him that had to be culled out. The plant, however, now in operation, shows that the mayor pursued business methods and secured good results. Two committees were appointed in the council to superintend the purchase and installation of the plant. The mayor was a member of each committee. The committee on building was made up of Messrs. L. Rogers, J. Lathan and H. Webber. The committee on steam and electric plant, Messrs. G. Mahan, G. Morahn and C. G. Walters. Mr. Charles G. Armstrong of Chicago was retained as consulting and supervising engineer.

It was determined to install and operate the lighting plant in connection with the water works system. The pumping station is located near the railway over which its supply of coal is received. The coal is shoveled from the cars into the coal room. The building was too small to accommodate the electrical machinery and practically a new building was planned and built. This building was erected of brick walls with trussed roof and every precaution was taken to guard against fire. It was built over the old building and as little of the machinery of the pumping station was disturbed as possible. A temporary boiler was put up to allow the old boilers to be turned, allowing a better arrangement of the boilers and the fuel to be handled more conveniently. The new building was planned by the consulting engineer and not only present needs were provided for but also an equipment of double the size. The pole line was constructed by the city. The poles are 30 and 35 feet long of good proportions, shaved and straight. Except at street corners where lamps are suspended the 30 feet poles were used.

In selecting the kind of lighting systems to be used the advantages of both the direct current arc systems and of the alternating were presented to the city authorities. After a hard fight the present system, which was advocated by the consulting engineer, was decided upon. This system is an alternating current system operating both incandescent and arc lights. The arc lamps burned from the 30-volt transformers and the incandescent from the 100-volt, the current on the mains being 1,100 volts. The city covering a considerable territory the economy of using the alternating system is at once apparent, both in the saving in cost of wire and in the distribution of the current. For arc lighting the arc lamps are as economical as the constant current arc lamps, each consuming 450 watts for a nominal 2,000 candle power lamp. Manufacturers have recently greatly improved the incandescent arc lamps, making them so they burn without resistance on the 30-volt secondary of the transformer. The voltage is steadier than in other forms of arc lighting, it being impossible for the difference of potential at the arc to fluctuate to a great extent. The demand on the machine is more uniform, giving a longer life to the armature of the dynamo.

On this system one lamp cannot affect another lamp on that system. If a short circuit occurs in a lamp the damage cannot extend farther than the transformer fuse, which may blow out, cutting off the single lamp. Other lamps, either arc or incandescent, are not affected. The objection is often stated that the alternating current arc throws the light upward and a portion of light is lost. Properly adjusted shades, as designed with most lamps, catch and diffuse these rays. The light is more widely distributed and at Sandwich where the lamps are some distance apart the result is all that can be desired. A test made of the lamps on July 20th showed the lamps consuming between 32 and 33 volts and 14 to 14½ amperes, while the total for 60 arc lamps was 30 kilowatts, a result which will compare favorably with any system. Nurnberg carbons are used and excellent satisfaction is secured.

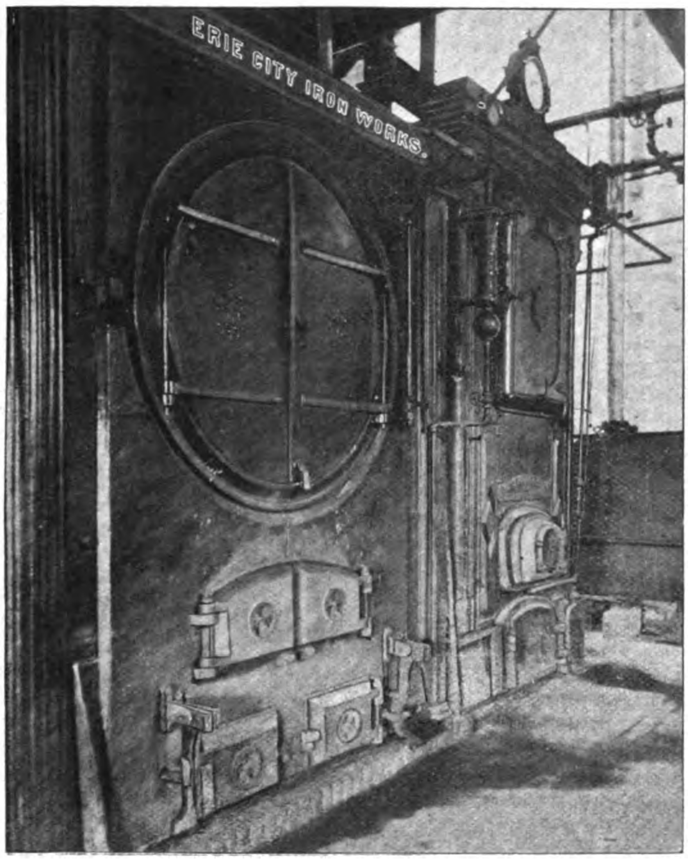

FIG. 2—THE CITY OF SANDWICH MUNICIPAL LIGHTING PLANT.

The contract for the electrical equipment was awarded to Horne & Martin, general agents of the National Electric Company of Eau Claire, Wis., whose electric apparatus is used throughout. The dynamo is of 65 kilowatts capacity with exciter armature mounted on armature shaft of alternator. The transformers for the incandescent lamps transform the 1,100 volt current to 100 volt and are mounted on the line poles. The switch board is a model of its kind, of white marble mounted on an iron framework. The marble is supported by brass bolts and all switches and exposed metal work are of polished brass and copper. The instruments are of National manufacture and are of very neat patterns. On account of the difficulty of procuring fuel and the hindrance of the strikes the wiring for commercial lighting has not been pushed, but commercial lighting will form an important part of the work of the station. Three hundred lights are now in use. Every customer is furnished a Thomson wattmeter and current is paid for at a standard rate.

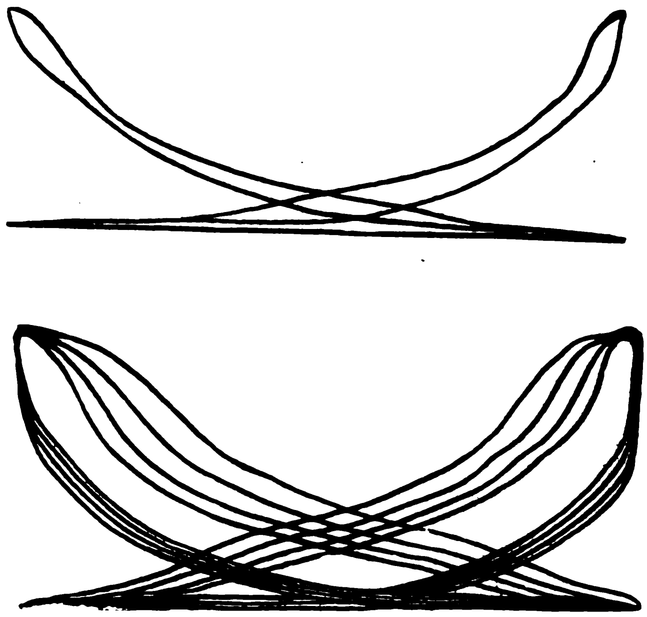

FIG. 3.—THE CITY OF SANDWICH MUNICIPAL LIGHTING PLANT.

The arc lamps were furnished by the General Incandescent Arc Light Company, which is one of the oldest manufacturers of arc lamps for incandescent circuits. The lamps are the standard type of lamp for alternating incandescent circuits. Some improvements in the mechanical details of the lamps have been recently made that increase the durability of the lamp. They operate very smoothly and the feeding of the carbons is scarcely perceptible. Five-eighths inch cored carbons for both upper and lower are used. The lamps are 12-hour lamps which is long enough for the longest run, the lamps being operated on a 12 o'clock moonlight schedule. The lamp is entirely enclosed and fully protected from the weather. Sufficient ventilation is given the lamp by means of the ventilating holes in upper part of shell. One of the advantages of this lamp operated on the 30 volt secondary is that no current is lost in resistance coils as happens when operated on higher voltage circuits.

The engine was installed by the Erie City Iron Works, which also installed a 100 horse-power boiler. The engine is rated at 110 horse-power at 275 revolutions. It is fitted throughout with sight feed oil cups. It rests on a foundation of brick laid in cement to which it is securely bolted. The engine is well proportioned. The base is broad and heavy and the governor effects a close regulation through varying loads. In Fig. 3 is shown some indicator diagrams taken from this engine under varying loads. The upper card was taken with no load on the dynamo and represents but the friction of the dynamo and engine. The lower card was taken as the different lighting circuits were cut out at night.

The boiler is of the special type of tubular stationary boiler manufactured by the Erie City Iron Works. They are made of steel plate which has a tensile strength of 56,000 pounds and under tests will turn over and close down solid without a fracture. The shell of the boiler is made of but two plates, one on the bottom and one on the top. There are no seams exposed to the flames and the bottom presents a smooth, even surface which prevents the lodgment of sediment and the consequent burning of the plates. The longitudinal seams are double riveted and the stays and braces are made of selected iron. The grates are of the regular pattern and of ample size. The stack is fitted with an automatic steam regulating damper and modern devices are everywhere used. The smoke stack, which was erected to accommodate the increased size of plant, is of riveted steel one-fourth of an inch thick, 75 feet high, mounted on a stone foundation without guys. It is 36-inches in diameter and has a steel ladder reaching to the top. It was erected last winter and showed no effects from the severe winds of last spring.

The electric plant has required the addition of but one man and the work is so divided that the water works and lighting plant receive full attention. The assistant engineer goes on duty at 7 A. M., and operates the water works until 1 P. M., when he is relieved by chief engineer, who runs the plant until it is closed down. The assistant engineer trims the arc lamps in the afternoon which, as the lamps are run on a moonlight schedule, a day's trimming amounts to not over 20 lamps. Some days there is no trimming to be done. During the summer when the evenings are short the water works require more attention and the lighting system less than in the winter when the conditions are reversed. The assistant engineer remains on duty until 8 or 9 P. M. In order to enable the attendant to turn off or on from the station the street arc lights without disturbing the commercial lights a third wire was run. The arc lights are connected in multiple between this wire and one of the other two, while the commercial lights are connected between the first two. A most economical use of wire is thus effected.

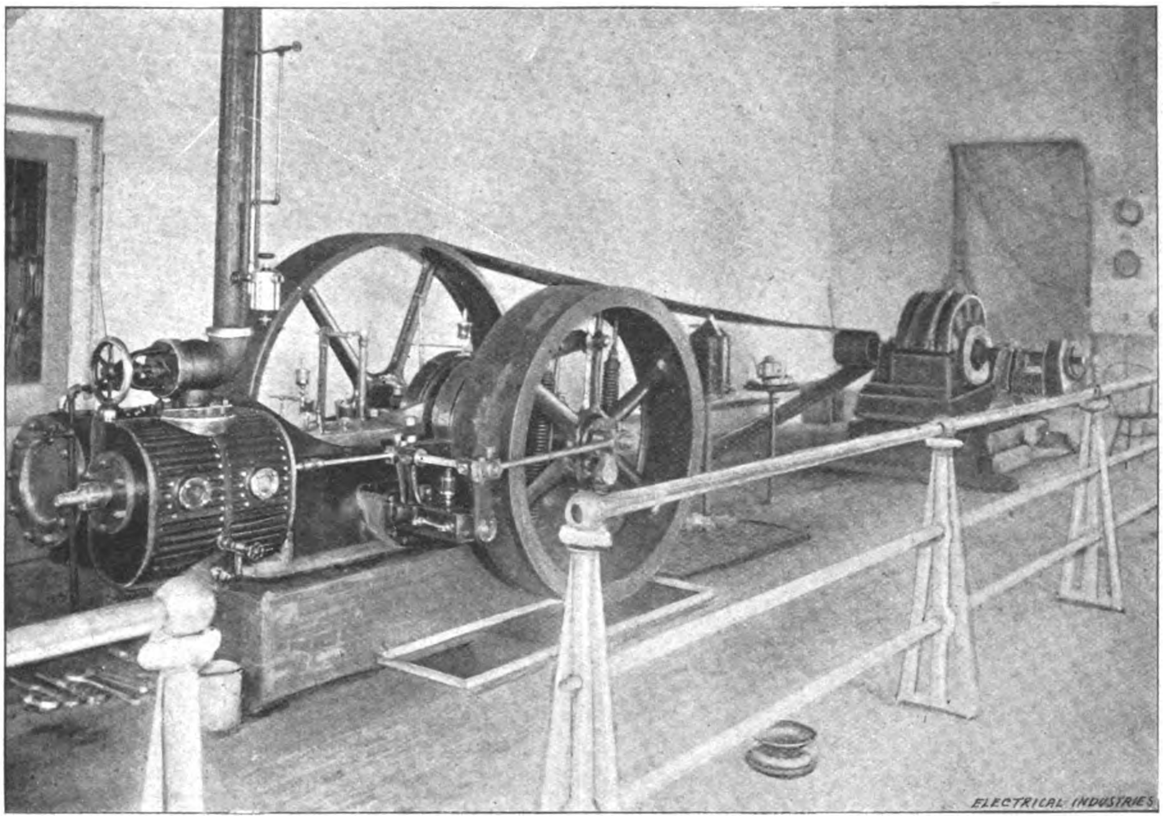

FIG. 4.—THE CITY OF SANDWICH MUNICIPAL LIGHTING PLANT.

Fires which occur along the line of a street railway, completely block the line while in progress. To remove blockades of this kind the patrol service of the Broadway line, New York, has been equipped with shear legs, and tackel. When a fire occurs on the line the patrol wagon with apparatus responds, and by raising a pair of shear legs on each side of the street the hose is raised to a height that will permit the cars to pass beneath. A sufficient number of these outfits are carried to support as many lines of hose as may be used. The shear legs are raised and lean toward the center of the street. A guy line fastened to the most convenient place holds the shear legs in position.

How Money is Made or Lost.

BY THOMAS G. GRIER.

In promoting the business of an electric lighting company it is not essential that the full rated capacity of the plant be connected up that the station can earn money. In fact, the number of lamps used is but a secondary consideration. The quality of the customers is what makes the dividends grow. The central station manager should educate his customers to burn their lights for as many hours per day as possible; for it is only when lamps are burned over a certain length of time per day that they become dividend earners.

A central station that averages two hours per day per light for 365 days each year barely pays for its maintenance, when the price of current is one cent per ampere hour. If, however, there can be added a few all-night lamps, or if the merchants of the town can be induced to illuminate their windows and keep them illuminated after the stores are closed, the average load of the plant will be greatly increased. Could this be increased so that the average load per lamp capacity of the plant per day equals three lamp hours per day, a dividend of 10 per cent may be paid on the capital stock at the end of the year. These figures are derived from carefully made estimates on a number of electric lighting plants of from 750 to 800 nominal 16-candle power lamp capacity. While some might be operated more economically in regard to fixed expenses, depreciation, etc., yet it is sufficiently accurate to point out the fact that commercial lighting to be profitable must be increased, not only in the number of lamps but also in the quantity of energy consumed by each lamp.

The complaint is frequently made that a company which owns the franchises does not extend its lines in order to supply a few scattered customers. Residence lighting gives at the best but small profit and is more often done at a loss. The manager should carefully classify his customers and those who use the lights but a short time, should pay a proportional larger prices. This should always be taken into account when making contracts. He should know the fixed charges for operating the station, the additional cost pro rata for each horse power developed and for each 16-candle power lamp burning on the circuits. He should also know the cost of renewals, which might be termed the pro rata depreciation of lamps, when reduced to the cost per hour. With this data the manager would be enabled to solicit business intelligently and know what customers will or will not pay.

The time is coming when these questions will be forced upon the managers by anxious stockholders when they are looking for dividends. Electric lighting is like any other business. One must know what his product costs to be able to sell it at a profit, and further, the nearer an investment can be worked for its full running time to its capacity the cheaper it can manufacture its product. I might further add that electric heating will come to the assistance of the central station in the near future.

The bill asking for an increase of capital stock of $30,000,000 of the Bell Telephone Co. has passed both legislative houses of the state of Massachusetts and been signed by the governor. This bill meets the objections made to the former bills presented to the house. The company agrees to the sale of the new stock at public auction in case the stockholders do not agree to take it at the market value..

Meeting of the Northwestern Electrical Association.

The midsummer meeting of the Northwestern Electrical Association was held at St. Paul, July 18th, 19th and 20th. The Hotel Ryan was the headquarters for members and the meetings of the convention were held at the hotel. Notwithstanding the unfavorable time of year and the warm weather, the association was well represented and the meetings were well attended. Central station, railway and supply men composed the majority of those present. A number of supply houses had samples of goods on exhibition at the hotel and considerable literature was distributed.

The opening session on Wednesday morning was called to order by Vice-President Baker, President Page being detained. This session was taken up in effecting an organization and preparing for the work which was to follow. The papers presented at the afternoon session were very interesting and were freely discussed. The first paper "Economy in the Boiler Room," by J. C. McMynn of Chicago was read by Mr. Fred De Land, Mr. McMynn being unable to be present. In the discussion that followed the reading of the paper much interesting information was brought out, including experience in the operation of plants of different kinds. The "Relations of Technical Schools to Electrical Industries," by Prof. George D. Shepardson of the University of Minnesota, was the second paper of the afternoon. The convention listened attentively to the reading of this paper and entered into a lively discussion of the subject at its close.

At the opening of the Thursday morning session the announcements were made of the various entertainments of a social nature that had been provided. Many communications were received from local companies extending courtesies to the members of the convention. At this session Mr. B. J. Arnold of Chicago read his paper on the "Cost of Producing Electrical Energy." This paper was especially valuable as it involved questions in which central station and railway men are particularly interested. At the afternoon session the first paper presented was "Economical Operation of Electric Plants from an Electrical Standpoint," by C. K. Stearns of St. Paul. A paper that was full of interest followed, "Incandescent Lamps; their Use and Abuse," by A. D. Page, of Harrison, N. J. The paper was accompanied by a number of diagrams that showed very clearly the depreciation in candle power of incandescent lamps after a certain number of hours use, etc. The next paper, "The Modern Dynamo," was read by Gilbert Donaldson of Minneapolis. The last paper of the meeting was read by Mr. Allen R. Foote of Washington, D. C. It was entitled "A Question of Public Policy." A special vote of thanks was extended to Mr. Foote by the convention and the paper was ordered printed for distribution.

The growth of the association and the extension of its field of usefulness is assured. A large number of applications for membership was received at this meeting. The following were by an unanimous vote elected to honorary membership: Prof. George D. Shepardson. A. D. Page, B. J. Arnold, Allen R. Foote, C. K. Stearns. J. C. McMynn and Gilbert Donaldson. The secretary announced the next meeting at Milwaukee in January, and also took occasion to thank the members for the close attention given to the proceedings of the convention. On behalf of the association he thanked the gentlemen who had contributed the papers for their efforts in making the meeting successful. The convention did not adjourn without thanking the many companies and individuals who had contributed to the employment of the members during their stay in the Twin Cities.

Among the social features of this meeting were many excursions to the pleasure resorts about St. Paul. Trips to Lake Como and Lake Harriet on Wednesday and Thursday, and on Friday a series of excursions were provided. The various electrical power stations were visited, the University of Minnesota, under the direction of Prof. Shepardson, and to other points full of interest and pleasure.

A Question of Public Policy.

One of the most valuable papers read at the meeting of Northwestern Electrical Association was that by Mr. Allen R. Foote, entitled "A Question of Public Policy—Shall Public Service be Rendered by Political or Private Monopolies?" Mr. Foot took for his text extracts from the platform of the Knights of Labor (Sections X and XIX). He carefully reviewed the opinions of Prof. Richard T. Ely, of the University of Wisconsin, on this subject. In conclusion he said: The demand for public ownership of natural monopolies was based upon the fallacy that the profit secured by private contractors or monopolies would thereby revert to labor or to the public. Hence the programme of the Knights of Labor. There was one economic advantage, however, inherent in private ownership, that could not be acquired by a municipality. The operation of this advantage created the profit for which a private company worked. Municipal ownership deprived industry of the economic value of personal interest. This value created the margin of difference between the two systems, all other conditions being equal, and was sufficient for the legitimate profit of enterprise.

The rising tide of socialism threatened to submerge the industrial world and destroy the present civilization. There were indications, however, that the turn of the tide was near at hand. There was a good number of municipally owned lighting plants, for both gas and electricity, a proper audit of the accounts of which would illustrate the economic fallacy of municipal ownership to the comprehension of a man less bright than the average. Those who now entered upon such a policy could do so only because they did not know or would not heed the teachings of experience.

That a change was impending in public policy regarding the control of public-service corporations was conceded by all economists, public men and business managers who were students of the subject. If the change made is to be for the good of the people, individually and collectively, it must be just to corporations. Mr. Foote asked all who would to adopt and advocate the following brief declaration and statements:

Declaration of Public Policy.—The best interests of the public welfare require, whenever a municipality can obtain a service for the supply of a municipal need, without creating a public debt or the investment of tax-payers' money for such purpose, at a cost to the users of the service not greater than it would cost if supplied from a plant owned and operated by the municipality, by contracting with a private company to supply such service, that the municipality shall have authority to make such a contract in accordance with the best economic conditions. These conditions require, in consideration of the investment of private capital for the purpose of supplying a public service and the organization by the owners of such capital of a company responsible for the proper management and satisfactory supply of such service, that the municipality shall secure to the company by contract, the full enjoyment of economic advantages that shall be the equivalent in every respect of the economic conditions that the municipality would enjoy if it owned and operated on municipal account, a plant for supplying the same service.

Authority for Municipal Ownership of Plants Supplying Public Services.—A municipality shall have authority to acquire the complete ownership of any plant owned by a private company and operated by it under contract with the municipality for supplying a public service, by paying the full value of the same when judicially determined, whenever it has been demonstrated beyond a reasonable doubt by judicial investigation, than an economic gain for the public welfare can be secured by such action, sufficient in amount to justify such change in public policy, and then only.

To Safeguard the Public Welfare.—To safeguard the public welfare, all contracts made under authority of this provision shall stipulate that the company is to erect and extend its plant so as to supply the service, in the best known manner and at the lowest practical cost to the users of the service, to every section of the municipality whenever and wherever the municipal authorities may from time to time require; that it shall fix its charges for the public, commercial and private use of the service it renders at such rates as shall be only sufficient to cover interest on its outstanding shares of stock and bonds legally issued, at the same rate the municipality pays on its bonded debt, a reasonable allowance for the depreciation of the value of its plant from use, accidents, and contingencies, all operating expenses and the value of all material consumed in the processes of operation and ordinary repairs, and a net profit for dividends of not to exceed 10 per cent per annum. All such contracts shall stipulate that the prices fixed by the company for the service it renders shall be subject to review by the municipal authorities at the termination of regular periods of five years each; that the extension of the service plant, the adoption of improved apparatus, methods of distribution, or system of management, designed to render the production or final use of the service better or more economical, may be required by the municipal authorities at any time.

To Safeguard the Welfare of the Contracting Company.—To safeguard the welfare of the contracting company, contracts shall stipulate that no extension of the service plant, change of apparatus, method of distribution or system of management shall be required by the authorities of a municipality unless the rate of charges for services rendered and the income from the same, actual or prospective, be sufficient to fully pay the considerations for service rendered herein specified, but the contracting company may consent to make extensions or changes of any kind whenever requested to do so by the municipal authorities, without reference to the effect such changes may have upon investment in relation to income.

To Safeguard the Mutual Welfare of the Public and of Contracting Companies.—In case of a disagreement of any kind between the authorities of a municipality and a contracting company, such disagreement shall be settled by a Board of Arbitration selected for the special purpose, the company naming one, the municipal authorities naming another, and the two members so selected naming a third, the findings of the Board of Arbitration so selected to be final and binding upon the company and upon the municipality.

Economical Operation of Electric Light Plants From an Electrical Standpoint. *

BY C. K. STEARNS.

The object of this paper is not so much to explain in what way electric light companies can most economically operate their plants as to discuss one or two methods which may prove advantageous to central stations. During these days every one is striving for economy, and electric light companies are endeavoring to discover leaks in their system, which, when remedied, will at least reduce their operating expenses, and enhance their receipts. New stations are putting in compound and triple expansion engines, using condensers if possible, even though the first cost is greater.

Direct coupled slow speed dynamos are used to avoid the loss and annoyance of belts. Dynamos are selected of such size as will keep the separate units loaded to their maximum capacity the greater part of the time. Long lengths of shafting are avoided if possible. Heaters, highly efficient boilers, mechanical stokers capable of burning cheap grades of coal, and economizers, are used, thus utilizing all the heat possible. High insulation of their lines are demanded. Lubricating oil is filtered and used a second time. Coal is weighed and the best quality demanded for the purpose. Everything is brought down to a system which conduces to economic operation. In fact, the manager must know what everything is costing from day to day, and in this way keep a check on his expenditures.

A great many stations keep an ampere record taken at stated intervals, and in this way form an approximate idea of what their load is during the time of operation. They are content with an approximation of their output, but demand that an accurate account be taken of the coal, oil, and water, etc. By the use of recording meters, preferably Watt meters, on their different circuits, an accurate record can be kept of the output. And not only this, but the manager can form a just opinion of any excessive loss between his coal pile and the lines. Thus, knowing the amount of power put out over his lines, and knowing what to expect from his dynamos, engines and boilers. It is a simple matter to determine how much coal and water are needed. Suppose, for instance, that the station is divided into units, and we have a watt meter on each unit, and at the end of the day's run it registers 1,000 horse-power hours. Suppose, also, from the statements given us of the efficiency of dynamos, engines, etc., we may expect three pounds of coal per horse-power hour, and 20 pounds of water per horse-power hour, the amount of coal burned should be 3,000 pounds, and of water consumed, 20,000 pounds, during the run. These figures should check up with the weights given by the engineer. If they do not there is evidently a leak somewhere, which should be investigated. By the use of recording watt meters on each circuit, or a total recording watt meter, in small stations, this record is invaluable.

Watt meters can be purchased now which are applicable to direct and alternating circuits (either primary or secondary), and will prove a check not only on the station operation but on the outside lines. This brings us to the discussion of supplying lights by the contract system or by meter. It seems to be conceded that with an accurate meter the most economical method for both the customer and the company is to sell on the meter system. This fact is strongly brought to our attention during the present depressed times by the number of stations which are changing from the contract system to the meter system.

I stated above that it was economical for the customer. Under the contract system the customer naturally becomes extravagant in the use of light—in fact, he wishes to "get his money's worth." Extravagance in one line will lead to other extravagances, so I contend that although the shock to the consumer by changing from contract to meter may be severe, he is benefited in the end. From the producer's standpoint it is a benefit, as may be shown by the numerous statements of station managers. In fact, I have failed to find one who did not believe the change was a benefit to him. Under the contract system the customer uses all his lights, whether he needs them or not, and the result is, your station is fitted out with a dynamo capacity equal to your maximum load, which occurs between 7 and 9 o'clock in the evening. Before 7, and after 9, your load is light, and your machines are idle.

With the meter system of course your load will be heavy between 7 and 9 P. M., but your maximum load, with the same number of customers, will be at least 30 per cent less. This statement is amply proved by the testimony of numerous stations adopting the meter system. It is obvious that the proper time to make the change is in the summer time, when the ampere of lamp hours of each customer is at its minimum. When the change is made the customer burns his lamps with his customary extravagance. His bills, as a rule, will therefore show a marked increase over his contract rate, and will continue so until such time as the customer learns to burn only such lamps as are needed. It does not necessarily follow that in operating on a meter basis the individual bills will be greater, in fact, in many cases it is the reverse. An investigation of stations run on the meter system shows most conclusively that they are more profitable than those operated on thecontract system. The reason is simple. "The lighting company saves the power which would otherwise be wasted by the consumer's extravagance." In this way the surplus power found after the change from contract to meter system can be used in extending the service.

The actual number of hours during which a consumer's lights are burning, multiplied by the number of watts per lamp, gives the consumption in watt hours for that night. Now if the total contract rate be divided by the number of lamps in use, and the result divided again by the total number of actual lamp hours of service, it will generally be found that the existing income per burning lamp per hour is surprisingly low. This condition of affairs arises not so much from the customers' monthly bills being small, as from the fact that a large amount of useless light is carried more or less constantly upon his circuits; light which is of no service to the customer, but which is none the less an expense to the lighting company.

If the basis of charge were made to meter, and the rate so placed that the customer would pay for the light really needed about what was previously paid by contract for the wasteful service, the consumer would speedily learn to so economize as to use light only where really useful, thus reducing the real consumption, while practically the same income would be received. Consumers are almost always well pleased with this arrangement because it leaves the amount of their bill entirely dependent upon their own economy, while if their lights remain unused there is no bill at all. Further economy results from this system when lamp renewals are furnished by the lighting company, inasmuch as the life of the lamps is greatly increased by reason

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* Abstract of paper read before the Northwestern Electrical Association at St Paul.

of the discontinuance of the wasteful burning. I have mentioned that the record shown by the total watt meter in the station would be a check not only on the coal pile, but also on the lines. On the contract system this will form a check, but on the meter distribution will serve as a detector of leaks in the line, every watt of which is recorded. Gas companies have found it necessary to use a large meter to measure the total consumption, and it is equally important in the electric light service. The sum of the indications of the consumers' meters, plus the loss in distribution, plus the drop on the lines, should equal the reading of the station meter. On the alternating circuit the loss in the transformers should of course be taken into account, and it will show whether these losses are excessive. In this way it may be possible to so distribute your transformers that they are more nearly kept to full load and a consequent saving made.

For commercial arc lighting recording watt meters are made which can be relied on, and unless your contract rates are particularly favorable much more satisfactory returns can be obtained from the same station output by the use of meters than by the contract system. The public is still skeptical regarding the accuracy of the gas meter, although the present form has been in use for the last 20 years. It is, however, a very reliable instrument, but we have electric meters to-day, which are more accurate than this much abused gas meter. Although the records of the patent office show that this subject of electric meters has been studied for the last 10 or 15 years, there are comparatively few prominent recording ampere or watt meters.

Probably the first in the field was the Edison Electrolytic Meter, the principal of which is the use of an electrolytic cell or cells, placed in a shunt circuit, the resistance being so proportioned that a definite fraction of the current passes through the cell. The chemical action of the meter when in use consists in depositing metal from one electrode to another, the rate of deposit being equaled by the amount of current passing through the meter. The electrical energy consumed is measured by the increase of weight of the electrode which receives the deposit. This meter is undoubtedly accurate, and extensively used, although it has the disadvantage, from a consumer's standpoint, that he cannot read the meter himself; he must rely on the central station's word as to the amount of ampere hours burned. Of course he can roughly check it up by keeping a record of the number of hours he has burned his different lamps, but he is at the mercy (from his standpoint), of his lighting station. From the managers' standpoint there is considerable trouble and expense in renewing and handling the cells and acid.

The Shallenberger meter, of the moter type, is devised for alternating currents only. In this meter we have a metal armature capable of rotation; this armature rotates in two fields of force, the axis of one of which intersects the axis of the first. The armature operates a train of gears representing the revolution of the armature. To retard the speed of the armature fans or vanes are provided. The difficulty of this type of meter, which is only applicable for alternating currents, is to produce the proper speed under light load, and to produce the proper retarding effect by the vanes.

The Aron meter, invented by Dr. Aron of Prussia, registers the amount of current consumed by noting the difference in the rate of movement of two clocks, one of which is affected by the passage of the electric current. The apparatus consists of two pendulums regulated so as to have synchronous oscillation. The left hand pendulum is of the usual construction; the right hand pendulum carries at its extremity a steel magnet. Each pendulum is kept swinging by a clock movement actuated by a spring power. Both pendulums act jointly upon a dial train, which counts the difference of their oscillations. As long as no current passed through the counter coil below the magnetic pendulum, both pendulums oscillating synchronously, and the train is at rest. As soon as current passes through the large coil, however, the time of oscillation of the magnetic pendulum is affected, so that it swings faster as the current passing through the coil increases the dial train registering the oscillation of the magnetic pendulum. The degrees on the dial are multiplied by a constant obtained for each meter, to obtain the current consumed. This meter is quite expensive, although accurate. It requires winding up once in thirty days.

The Walker meter is practically an ammeter, registering the current by means of photography on a strip of sensitive paper operated by clock work. A line is thus marked on the sensitive paper by means of a small incandescent lamp, placed in front of the dial. The sensitive paper is developed at certain periods, and the area found by means of a planimeter. The consumer cannot, of course, read his meter, unless equipped with the necessary appliances.

I now wish to call your attention to the Thomson recording watt meter, a description of which is best given in the words of Mr. Caryl D. Haskins. To exactly fill the requirements a recording watt meter should meet the following conditions: It should register watt hours, that is, the amount of power and not current, delivered to any circuit. It should be adapted to either continuous or alternating circuits. The instrument should be accurate throughout its entire range. It should combine simplicity of design, with noiselessness and durability.

The meter is simply a motor of the most elementary nature, driven by the same source of electrical energy which it is to measure, and its notation during any period is proportioned to the power or watt hours delivered to the circuit during that time.

The instrument consists of a simple skeleton motor, having no iron in either armature or field. The fields, which consist of two coils, one on either side of the armature, are connected in series with the lamps or motor, whose absorption of energy they are to measure, all the current in use passing through them. The armature is of the "Siemens-Drum" class, having a small commutator and brushes with contact pieces. This is in shunt across the line, like a lamp, and having a considerable resistance of fine wire in series with it, forms a "pressure coil," its current varying with the voltage. It will readily be seen, therefore, that as the field varies with the current, and the armature with the pressure, the speed of the motor will vary directly with the power or watts in use, which is of course the ideal method of measurement.

The indications of the meter are shown in watt hours on the dial, gear or "train," the first wheel of which engages with a worm on the shaft, thus connecting it with the revolutions on the armature. The calibration of the Thomson Recording Watt Meter is readily and effectively accomplished by moving the poles of the permanent magnets towards or away from the periphery or centre of disc, thus thus increasing or decreasing its speed till it becomes synchronous with the standard instrument. The watt-hour forms a perfect and convenient unit for measurement, being an actual unit of power, and therefore readily comparable with all other standards, as well as simple in itself. One thousand watt hours may be taken as practically equivalent to one hundred feet of gas; thus the consumer, already familiar, as most consumers are, with gas practice, has a ready means of noting and checking his consumption of light.

There are other points, such as a recording volt meter, and a recording ammeter, which would no doubt be of advantage in large stations, but which would rather be a luxury than a necessity. Time will not allow of their discussion.

The Ferranti Station.

In a paper read before the electrical department of the Brooklyn Institute of Arts and Sciences just after his return from an extended tour through Europe, Mr. W. L. Barstow thus describes the great project of Ferranti.

The London Electric Supply Company, Ltd., has the distinction of being the pioneer in the public supply of electricity, and is worthy of something more than a brief mention. Originally known as the Grosvenor Gallery Electric Supply Company, it began work by supplying light to the Grosvenor Picture Gallery and Library in Bond street, from a station in the basement of that building. After a time, the light being found to work satisfactorily, a number of buildings in the neighborhood had connections made by means of overhead cables, and the Grosvenor Gallery Company soon became the center of a small system of electric supply. The demand for light continually increased, and a number of large houses about Mayfair and Hyde Park were included, until in 1888—the year of the amendment of the electric lighting act—it was found impossible to supply more lights, the machinery being already overtaxed. From the encouragement accorded their efforts at the Grosvenor Gallery station, the directors considered that the supply of electric light might be successfully undertaken on a larger scale. The light was popular, and they saw clearly that in the near future the demand for it would increase with great rapidity.

About this time an engineer appeared on the scene of electric lighting, an engineer who, although he was by no means unknown, was the only man who would dare to undertake to carry out the enormous work which he himself had suggested. The plans and ideas which he submitted to the company were so far in advance of the times, and the results apparently so remunerative that he soon had back of him a capital of 1,200,000 pounds sterling or about $6,000,000 and a company of stockholders who were ready without question to submit to his decisions.

The following will give the general prospectus of the enterprise: An enormous station and also a duplicate required by the Board of Trade was to be erected in a suburb of London close to the water, so as to render condensing possible and coal cheap. This station by means of 20,000 volt generators and large engines was to supply this high volt current into the centers of the city of London. At these centers were to be located large transforming stations where the current of 20,000 volt pressure was to be reduced to a current of 5,000 volt pressure and to be distributed to arc circuits or transformed to a current of 100 volt pressure for incandescent lighting.

One of the main stations, the only one ever completed, is located at Deptford, about seven miles from Charing Cross, London, S. E., and occupies with its grounds an area equal to about twelve of one of our city blocks alongside of the Thames river, the building consisting of two enormous rooms, about eighty feet high, one for engines and generators and the other for boilers, roofed with iron and glass, and about the size of two of our city blocks. The boiler room is finished complete with 24 Babcock & Wilcox boilers of 500 horse-power each and there were to be two engines of 1,200 horse-power for light loads and four engines of 10,000 horse-power each, coupled to generators, the armatures of which were 42 feet in diameter. This enormous plant was to have been controlled absolutely, if necessary, by two men, who were located over the main entrance, in a room about ten by forty feet. In this room were to be glass covered switches for controlling the immense generators and steam levers for controlling every important steam valve in the building, so that from this room, engines or generators could be stopped or started at a moment's notice. Portable steam engines fitted to cranes unloaded the coal barges, two tons at a lift, and deposited the coal in the fire room after steaming along some four hundred feet of track. Tanks about 50 by 100 feet were located near the water's edge back of the station and connected to the river; in these tanks, on a sort of covered platform, was to located the condensing apparatus.

Before these large engines could be built ready to start, it was deemed best, on account of the high pressure to be carried, to commence operating some 300 horse-power engines, so as to get the insulation of the system in good shape.

The main trunk lines to the sub-stations, a length of some eight miles, were to be laid along the elevated stone viaduct of the railroad between the two tracks, but after a little experimenting, the railroad company decided that they did not want them there, and so Ferranti was obliged to fasten them to the outside of the viaduct. And now everything being ready, about three years ago was put in operation one of the most daring projects of modern electrical engineering. As the pressure gradually attained a voltage of 20,000 volts, numerous defects developed and shut-downs were frequent. At last the first 1,200 horse-power generator was built and started at a pressure of 20,000 volts and it became evident that it was like handling lightning. To that high pressure many substances which to our currents are insulators became for Ferranti first-class conductors, and his own design machine began to develop defects. In the first place no provision for conveniently removing the armature of the dynamo, had been made, and in order to remedy this defect, the massive fields of iron had to be sawed in two and bolted together.

As the system through the outside conductor was purposely grounded, the current impelled by its enormous pressure, did not wait to be kindly conducted off in a gentlemanly manner, but preferred to jump the air-gap in the machine directly from the armature conductors to the iron pole-pieces. This was one of the worst blows to the Ferranti system, for it not only became necessary to increase the air-gap, but also to cover the iron pole pieces with ebonite ½-inch thick, both of which changes reduced the maximum efficiency of the generator, as it required an enormous increase in the exciting current to try to make up for the increased air-gap.

And the outside system was damaged by local conditions. The stone arches directly under the conductors were rented as store houses, and frequent fires destroyed the insulation, no one being allowed to turn a hose on the fire until the engine at the primary station was shut down. In one way or another the service was interrupted every ten or twenty days.

All this time the large 10,000 horse-power units were in course of building and difficulties arose even here. There were no tools big enough to build the generators and engines, and a year was consumed in designing and building these necessary tools before any work was done on the units themselves. At last the ponderous castings were finished, the engine shaft about three feet in diameter, turned up, and the engine completed but not erected.

And now occurred what might be termed the final blow to the enterprise. One morning a workman was instructed to throw in a switch at the Grosvenor Gallery Transforming Station to connect a set of transformers with the trunk lines. The workman, probably a little nervous at handling 20,000, touched the two contracts of the switch lightly together. Instead of pushing in the switch, for some reason, only known to himself, he attempted to withdraw it and the spring snap thus rendered useless did not come into play. But the current of 20,000 volts did, and they say the antics cut up by that high pressure current was wondrous to behold. Before word could be conveyed to Deptford to shut off the current, Grosvenor Gallery was a mass of ruins.

Even then, the sub-station was temporarily rebuilt in forty-eight hours, but the Board of Trade stepped in and seeing the uninsulated conductors about to receive a pressure of 20,000 volts and the temporary switch-board, it did not hesitate to render a verdict that Grosvenor Gallery must be permanently rebuilt before current could be turned on.

This occupied about six months, and in the meantime the company's customers, tired of the continued promises of Ferranti, fell into the hand of the jubilant electric light and gas companies located in different sections of the city. And thus has almost perished an attempt to accomplish one of the greatest undertakings of modern electrical engineering. Ferranti has gone into business for himself. Deptford, once alive with engineers and workmen, is almost a silent tomb, and as one wanders through the grounds and immense buildings, he finds today the following condition of affairs: Everywhere about the grounds are large piles of castings, some ten feet high; and after looking over these ten or twelve piles one is informed that they are all that is left of the 10,000 horse-power generators and even these have just been sold for scrap.

Of the twenty-four boilers three are in actual use, and two 300 horse-power rope driven generators are operated at 5,000 and 10,000 volts. The lamps connected today are 20,000 and the prospect of increase is not a bright one, due to the poor service rendered. The engineers have declared that the enterprise fell through, not on acconnt of any part of the system being unsuccessful, but the public were not responsive enough in appreciating the light.

A few words here in regard to the position occupied by the engineer himself might not be out of place. Ferranti, although about thirty years old, was chief engineer, consulting engineer, and constructing engineer, building all the generators and engines himself and selling them to the company. But he was not manager, in fact, I believe, had Ferranti had the business management of the company he could not have failed to have seen the utter uselessness of completely equipping such an enormous station before he could even get an idea of the business in store. Like the great Eastern, his project was in advance of the times and failed on that account, if on no other.

Allegan, Mich., is to have a new telephone exchange. Harrison telephones will be used.

Convention of the Canadian Electrical Association.

The program which is being arranged for the next convention of the Canadian Electrical Association, held at Montreal, the latter part of September next, will contain matters of interest to persons in all branches of the profession. The subjects are varied and well selected; the men, to whom they have been assigned, are well-known in the different departments, and the provisions for discussions will increase the value of the papers. The convention will be held in the Mechanics' Institute building, which it is expected will accommodate in every way the requirements of the convention. The time set for the meeting is undoubtedly favorable for a good attendance. Many excursions are usually arranged at this time of the year to St. Lawrence river points, which members and visitors may avail themselves of. The ways of reaching Montreal are numerous and to those who like the water a trip by steamer will be found enjoyable. At Montreal and in its vicinity are many points of interest. Special arrangements will be made so that members of the convention may visit the more important places. The papers that have so far been provided include the following:

Paper on "The Possibility of Securing Better Regulation at Central Light and Power Stations, by means of Fly Wheel Accumulators of Improved Construction," by Mr. John Galt, C.E. and M.E., Toronto.

Paper on "A method of Distribution with Equalization of Potential Difference," by Mr. D. H. Keeley, of the Government Telegraph Service, Ottawa.

Paper by Mr. E. C. Breithaupt, Berlin, Ont.

Paper on "The Application of Electricity for Medical and Kindred Purposes, from Light and Power Circuits," by Mr. W. B. Shaw, Montreal.

Paper by Mr T. R. Roseburgh, Lecturer in Electricity, School of Practical Science, Toronto.

Paper on "Electrolysis," by Mr. J. A. Baylis, Bell Telephone Co., Toronto.

Paper on "Telephone Cables, their Construction and Maintenance," by Mr. F. J. F. Schwartz, Bell Telephone Co., Montreal.

Paper on "Alternating Motors," by Mr. L. M. Pinolet, Montreal.

Paper by Mr. John Langton, Toronto.

Persons wishing to attend or desiring additional information will do well to correspond with the president, Mr. J. J. Wright, or the secretary, Mr. C. H. Mortimore, Toronto.

Obituary.

O. G. Heilman died at Williamsport, Pa., on July 17th. Mr. Heilman graduated from Sibley College, Cornell University, in the class of '91, and had since been instructor in mechanical engineering.

Edmond Julien, who attained prominence in the electrical field, and was associated with Faure and Phillipart in the manufacture of storage batteries, died at his home in Brussels on July 5th. He was a distinguished citizen and received many honors from both the king and his countrymen.

Henry Alexander Bischoff, editor of the "Black Diamond," died on July 12th by his own hand at his office. He was widely known and respected. Popular among the western coal trade, he was most successful as the editor of its official organ.

Lynn laboratory, two summers ago, some of his larger home-made lightning. Indeed, potentials of 100,000 volts are less rare today than potentials of 5,000 volts were five years ago. All who saw the Thomson and Tesla exhibit at the Electrical building, Chicago, will easily believe that it is within our power to turn the fleeting high potential lightning into a current of lower potential and use it.

Professor Trowbridge, of Harvard University, in a discussion of some photographic negatives, shows that "the discharge follows exactly the same path in air for three hundred thousandths of a second, and adds that "it is probable that an ordinary discharge of lightning of a few hundred feet in length could light for an instant many thousand incandescent lamps if it were properly transformed by means of a step-down transformer." The eye alone cannot give a complete history of the myriad minor flashes during a thunderstorm. The charred, though to us intensely brilliant, crack in the air which we call lightning is but a great splash in the ether ocean. The waves and ripples come tumbling along in all directions, spreading rapidly, aye, very rapidly, nearly 200,000 miles per second. Given a proper resonator and the waves will do work. If my reader keep every sense on the alert, he may happen on some strange illustration of work done by lightning, now all unsuspected. In the tinkling of the telephone bell, the blinking of an incandescent lamp, the melting of a fuse, or the tiny spark from a gas pipe or loose wire, is the constant proof that there are more things going on between heaven and earth during a thunderstorm than most of us dream of in our philosophy.

ODDS AND ENDS.

The steamer Faraday has broken the record in Atlantic cable laying. The actual time consumed in laying the new cable of the Commercial Cable Co. was 20 days. The Faraday anchored off the Port of Causo, N. S., on July 4th, after completing the work of laying the new cable.

The street car lines of Detroit, which comprise about 80 miles of track with equipment, were recently purchased by Mr. Thomas Nevins of Orange, N. J. Less than one-half of the lines are equipped with the trolley. The price paid for the road is said to be $8,250,000, of which $4,000,000 is to be in cash and the balance in bonds.

The steamers Britannia and Scotia are now engaged in laying the new Anglo-American cable. The shore ends are laid by the Britannia and the deep sea cable by the Scotia. This new cable is said to be the longest in the world. The cable is attracting considerable attention not only from the above fact, but also on account of the claim made that messages can be transmitted much more rapidly than by any of the cables now in use.

The Canadian patent on the Edison incandescent lamp expires on November 1st, 1894, and the question arises, whether the United States patents expire at the same time or hold good until January 1897. This is a point for the courts to decide. The owners of the Edison patents continue their fight against other manufacturers of incandescent lamps but not always with success.

One of the latest uses to which paper is being put is the manufacture of telephone and telegraph poles. Its use in the manufacture of the higher grade of car wheels and in many other important industries leaves no doubt of the possibilities in this direction. The paper pulp, to which preservative and hardening compounds have been added, is cast in a mould. The pole comes out hollow, of the desired length and shape. They are light and strong. The action of the elements which cause the wooden poles to speedily decay, it is said does not affect these poles.

For many years electricity has been used for exploding the dynamite and other high explosives used in mining or excavating on public works. The electrical blasting apparatus which is commonly used for this work is not a light or handy thing to carry around all day as those who have tried it well know. This apparatus will undoubtedly give way to the recently devised pocket batteries which are designed for this work. These light batteries will be as handy to carry as a roll of fuse, and the accidents which are apt to occur from premature explosions will be avoided.

In the report recently made on the oil fuel used at the World's Columbian Exposition, Mr. Charles F. Foster, who was the mechanical engineer of the exposition, gives the total amount used in the main boiler room as 10,614,000 gallons. The contract price for the oil delivered was 72½ cents per barrel of 42 U. S. standard gallons. The cost for fuel per horse-power hour for power so generated was 6.3 mills. The amount of coal which would have been required is about 600 tons per day. To handle this amount of coal would have been a most difficult undertaking. Mr. Foster estimates the saving by the use of oil fuel to be 27 per cent.

The Spokane (Wash.) Street Railway Company has during the past few months had in operation a freight service on its lines. The transfer of grain and mill stuff between the mills and railways has heretofore been done by teams. The lines of the street railway reach these points and by the passage of a city ordinance the company has been enabled to establish this freight service. The curves of the track, etc., necessitated the construction of special cars, which were built at the shops of the company. The service rendered has been so satisfactory that it will undoubtedly be extended. Sidings are run from the main lines to the mills and stations. When loaded with grain the car is run over the mill sink and the hopper opened and the grain run out. The city ordinance provides that the charges shall not exceed 20 cents per ton for single trip and if loaded both ways 15 cents per ton. At these prices the service has been satisfactory both to the railway company and to its customers. In the month of February one car handled in 230 hours 64,000 bushels of wheat.

The work of transforming the horse car lines into electric lines which has been carried on so extensively on the south side, will soon be taken up on the west side. The contracts for the power station have been awarded and application has been made to the Department of Public Works for permission to rebuild the tracks and construct the overhead equipment. The Van Buren street line will be the first one to be operated by electricity. From Halsted street the electric cars will be drawn as trailers on the cable line. The work of reconstruction will be done by the railway company and will be pushed gradually until all lines now operated by horses shall have been electrically equipped. The station is to be erected near the present repair shops and barns on Washington boulevard and Western avenue. It will be near the center of the territory covered by the electric lines. For the electric station of the North Chicago Street Railway, which is also preparing to rebuild its horse car lines, the plans are already drawn. It is expected that it will require several years to complete the work but the first cars will be running next spring. This change will cover some 200 miles of track.

or discussion regarding the ownership and validity of patents. In this strife hundreds of thousands of dollars are annually spent. This does not, however, settle the points at issue. Long after the courts have rendered their decisions or the life of the patents has expired, there still appears in the papers a disscussion as to who really did invent a certain piece of apparatus or system, or discover a certain fact or law, or to decide whether sufficient credit has been given to some individual for his assistance in perfecting an invention. While justice should be accorded to all men, and a public benefactor should receive a sufficient reward, it is difficult to overcome the selfishness of humanity, or to remove an idol from the mind of the public which has occupied an elevated position for one or more generations. This strife, however, has undoubtedly a beneficial effect. It keeps prominently before the public the value of such workers and encourages, rather than discourages, those engaged in such occupations. It disseminates knowledge respecting patents that will enable inventors to better protect their rights. These strifes are probably due to several causes. All great inventions are the consummation of the work of previous ages. The work of each generation is added to that of the preceding. The workers of any one period are each endowed with the same fund of knowledge, and follow oftentimes in their investigations the same lines of thought. Thus we hear announced from widely separated cities at almost the same time a discovery. Two investigators, in different countries, unknown to each other have been working along the same line and reached the same conclusion at the same time. Each is an inventor and to each will his own countrymen give the credit. A similar instance might occur in the same city. Among a group of workmen there may be one who at some moment has formed roughly in his mind the outlines of of a certain mechanism. He has but the outlines; the details do not appear to him and he abandons it. A fellow workman catches but a faint idea of the purpose and outlines of this mechanism. He realizes its value and sets to work in a systematic manner to develop this idea into iron and brass. After a long period of patient toil it is accomplished. The first workman saw but a faint outline of the future apparatus. The second workman caught it and brought to perfection the apparatus. In a history of modern inventions and machine construction many similar instances appear in which several persons have been engaged in the perfection of the completed article. One appropriates the work of another and it is most difficult to give each a proper degree of credit. To the inventor the world is immeasurably indebted. The growth of the electrical industry is marked by discoveries and inventions which have built it up, and the rapidity with which one discovery followed another quickened its advancement.

Electricity is being employed to a large extent on all recently constructed steamers whether for passenger or freight service. Several of the new excursion steamers that have been placed in service this summer have most elaborate electrical equipments. The systems of lighting have been most complete. Not only are the interiors elaborately and artistically lighted but also the exteriors, making the evening rides most attractive. Parts of the boats, otherwise unattractive, are made bright and pleasant. The facility with which electricity is distributed, permits fans and ventilating devices to be distributed throughout the boat so that all parts receive a supply of fresh air. Electric elevators, cranes, signaling systems, etc., are some of the applications of electricity for marine service. Among the new applications of electricity in this connection is an electric steering compass, designed by a lieutenant in the French navy. Others have attemped the same thing but their apparatus has not proven practical on being tested. This, however, has been in use several months and the results, as reported, are more than satisfactory. A number of firms are giving their entire attention to marine lighting.

The Storage Battery of the Air.

The study of the electricity of the air, to which Franklin gave so much attention with such valuable results, will always possess great interest to students. In a recent number of Harper's Magazine Prof. Alexander M'Adie has an article entitled "The Storage Battery of the Air," in which he gives some interesting facts on this subject as follows: The air will stand a strain of about 9,600 grains per square foot before breaking. That is, the flash will occur when the electrical pull amounts to this, 1.37 pounds per square foot. For the energy of a cubic mile of strained air just before the flash we have, then, about 70,000,000 foot tons. The average thunder head or cumulo-nimbus cloud is not a mile high, however. For a small cloud, one a hundred yards square, and distant only a quarter of a mile, we would get about 300-horse power. Now a flash even a quarter of a mile long means a potential of many million volts. We cannot at present measure this directly, but we can determine the potential of the air within certain limits on any day, thunderstorm or no thunderstorm.

In 1885, at Blue Hill Observatory, and in subsequent years, we measured the potential of the air with insulated water-dropping collectors, after the methods of Thomson (now Kelvin) and Mascart. The top of the hill is 600 feet above the surrounding country; but with Franklin's idea of reaching out a little further from the earth, I ventured to use at times a large kite, tinfoiled, and for kite string some 500 feet of hemp fish line wrapped about with fine uncovered copper wire. During thunderstorms the sparkling and sizzling at the electrometer end of the kite string were incessant and startling. And even on cloudless days I found it possible to draw sparks, reading at the same time on the electrometer from minute to minute the electrification of the air in volts. In 1886 and 1887, in some investigations carried on by the Chief Signal Officer, and more immediately under the supervision of Professor Mendenhall, I experimented at the top of the Washington Monument, at that time the highest edifice in the world. The investigation continued many months, but perhaps days on which severe thunderstorms occurred were most impressive.

It being beyond dispute, then, that high potentials can be obtained from the air, the question naturally ensuing is, Can we not use them? With three or four sparks as small as those mentioned above, a large fruit jar can be cleared of smoke with which it has previously been filled. Perhaps nature repeats this on a large scale with lightning and clarifies a foul, dust-laden atmosphere with these great sparks. It may be, too, that these sparks are all needed, and, to attempt to divert them would be unwise. Be that as it may, we are living in an age of "step-up" and "step-down" transformers; an age when, for the first time in centuries, we are perilously near duplicating lightning. Until recently we studied lightning only in miniature. Prof. Elihu Thomson was kind enough to show me in his

The Knapp Electrical Works.

MYRON A. KNAPP.

The importance of the electrical industry is nowhere better shown than in the offices and warerooms of a modern electric supply house. Its history is also illustrated by the rapid growth of these business houses. The invention of the telegraph, and the construction of many lines for electrical communication, created the first demand for electrical devices and material. Subsequent inventions which now number thousands, have caused a rapid extension of the industry and created a demand for appliances and material in the manufacture of which hundreds of thousands of hands are now employed. To the supply houses who are in constant communication with the consumers, we are indebted for many of the improvements in appliances and methods of installation. Always on the lookout for anything that will benefit the central station manager or engineer they have brought to the attention of the public inventions and improvements which would otherwise have been unnoticed.

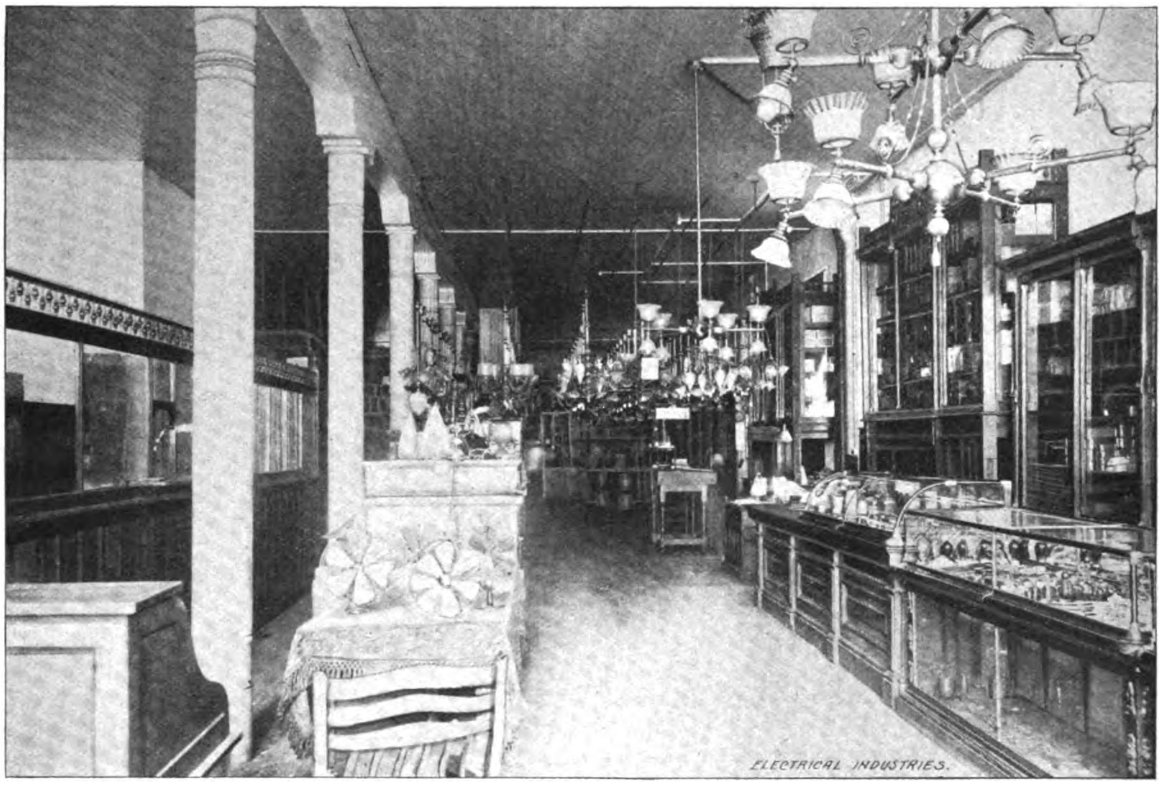


FIG. 1.—THE KNAPP ELECTRICAL WORKS—SALESROOMS.

The Knapp Electrical Works is one of the oldest dealers in electrical apparatus and material of Chicago. The growth of this company is identical with the growth of the industry. It commenced business as the Railway Telegraph Supply Company, dealing exclusively in telegraph supplies and material which constituted then the only field for electrical goods. With the activity in the construction of telephone systems, and the invention of the systems of electric ligthing, material for these departments were added to the line of supplies. The business of the company rapidly extended, and through the unexcelled facilities afforded by the many railroads radiating from Chicago, the trade of this house reached every section of country throughout the middle and western states. The handling of supplies and electrical apparatus has formed but a part of the business of this company. It early undertook the manufacture of electrical specialties, and has gradually increased this department from the small beginning made some ten years ago to the extensive factories now operated. The extension of this branch of the business, as well as the growth of the supply business, has required several removals. The original quarters, at the corner of Fulton and Union streets, were outgrown at an early date. Larger accommodations were secured on Franklin street for the offices, salesrooms, shops and warerooms. The building at 54 and 56 Franklin street was long known as the headquarters of this house. The two upper floors were occupied by the factory in the manufacture of the lighter specialties. The offices and salesrooms were located on the first floor, and the other floors were used for storing the large stock of wires, fixtures, appliances and specialties of all kinds.

M. B. AUSTIN.

On January first of the present year, after some time spent in looking for the best adapted location for the needs of the company which had again outgrown its available room at 54 and 56 Franklin street, the present building at 271 and 273 Franklin street was leased. The company took immediate possession and now has ample room. This building is well located, being easily reached from all parts of the city by the city railways. It is directly opposite the east entrance to the new Van Buren street tunnel, and diagonally opposite the proposed terminal station of the Metropolitan elevated railway. It is also well located for the reception and delivery of freight. There are some 40,-

000 square feet of floor space occupied, and two of the floors are double decked to provide more storage room. The upper floors occupied by the factory are well lighted and commodious. The machinery and shafting has been so arranged as to give every facility for the rapid production of first-class specialties. The foundry, where are cast the many small and large pieces of metal that go to make up the larger and complicated devices, is located on the top floor. On the same floor is also located the assembling rooms where the many artistically designed fixtures for which this house is well known, are assembled. A specialty is made of fixtures, and the new designs which have been brought out the past season have been much admired. Many hotels and apartment houses have been equipped by this company throughout with fixtures, and in this line the trade has been extensive. From the trade, orders are being constantly received for both the standard patterns and special designs.

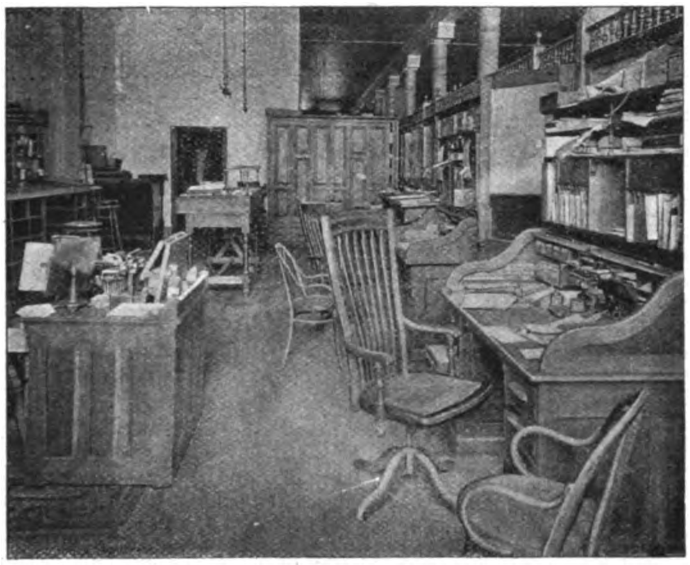


FIG. 2.—THE KNAPP ELECTRICAL WORKS—GENERAL OFFICE.

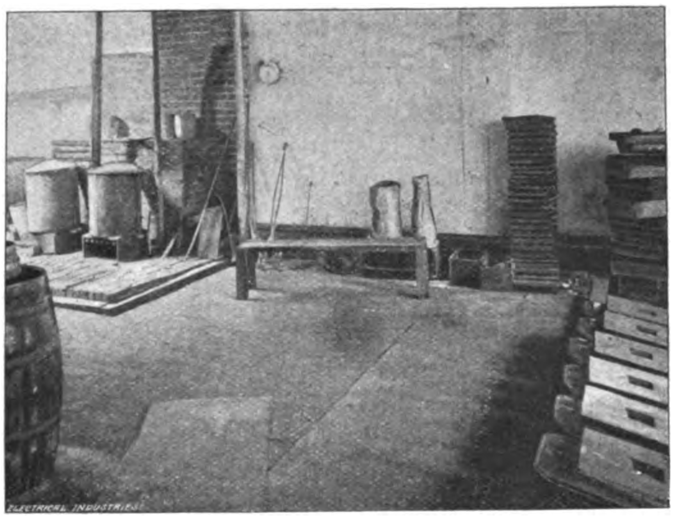


FIG. 3.—THE KNAPP ELECTRICAL WORKS—VIEW IN FOUNDRY.

The Knapp Electrical Works is one of the largest manufacturers of drop needle annunciators. The new knife switch recently designed, has been adopted by the Chicago Edison Company for its standard service switch, and by the trade the Knapp switches are largely used. For the manufacture of the larger goods, insulated wire and articles requiring a large amount of space in their manufacture, a factory has been located at one of Chicago's growing suburbs which has excellent shipping facilities. The company executes many special orders for customers desiring a particular kind of apparatus. To enumerate the many kinds of electrical supplies manufactured and handled by this company would require a large volume. A glance at the new catalogue just from the press gives a very good idea. It contains some 500 pages, is bound in cloth, and is finely printed on heavy enameled book paper.

The company is the western agent of the Safety Insulated Wire and Cable Company of New York, and among recent contracts for the underground cable of this company, is one amounting to nearly $25,000 from the city of Detroit. As western agent of the Ries Electrical Specialty Company of Baltimore, western customers are supplied with the Ries regulating socket, Ries fan motor, etc. The sales of iron clad Climax starting boxes and stage dimmers have been extensive. Among the largest customers of the house are the telephone companies who purchase large quantities of telephone material. Telephone cables, aerial, underground and submarine, are standard goods among users. Many specialties are also made and handled of new designs which are favorites with the trade. The new colored telephone cords and small wires which match the colors of the hardwood interior finish of offices, etc., are being extensively used in the recent installations.

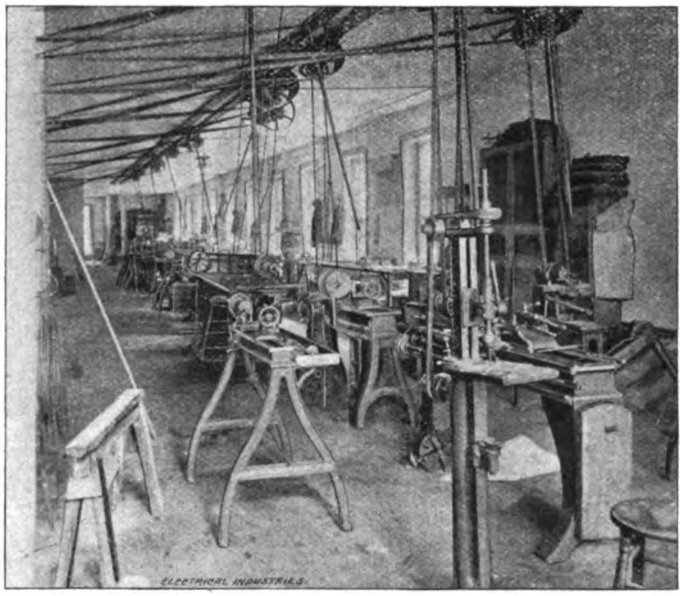


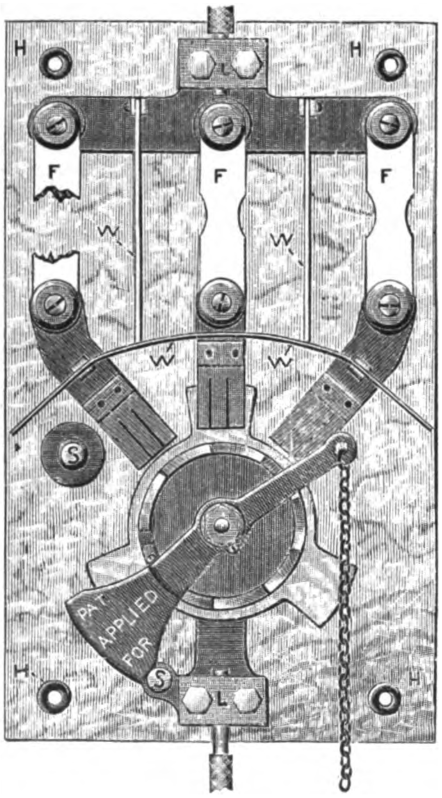
FIG. 4.—KNAPP ELECTRICAL WORKS—A VIEW IN MACHINE SHOP.

The rapid growth and success of this company is largely due to the enterprise and farsightedness of Mr. Myron A. Knapp, who, as general manager of the company, has determined its policy and directed its affairs. Becoming interested in the company in 1884 he saw the field that was opening to electrical supplies and determined upon adding a factory for the manufacture of electrical specialties. After Mr. Knapp secured a controlling interest in the old company, he changed the name to the Knapp Electrical Works, and has since conducted the business on a broad but substantial plan. Being widely known among the electrical fraternity, his own acquaintance with the trade, and his standing as a business man, have aided greatly in building up the extensive business enjoyed by the company. Mr. Knapp has gathered about him men of experience and skill who have taken an interest in the affairs of the house and endeavored to promote its interest. His assistant, Mr. M. B. Austin, has for several years been identified with the business of the company. As a youth he entered the employ of the Western Electric Company with whom he remained for six and a half years, acquiring both a general knowledge of the electrical trade and much valuable information concerning electrical apparatus and material. The acquaintance formed in his earlier work has since been widely extended.

To customers of the house, the name of Mr. Watson is familiar. As cashier he is one of the most important members of the company, and discharges the duties of his position to the satisfaction of all. Mr. Pessinger is in charge of the fixture department, which has grown rapidly under his direction. Mr. H. P. Brauns looks after the city order department, his extensive Chicago acquaintance being of great assistance in this department. Among the salesmen with whom many of our readers are familiar, are Mr. E. R. Crolies, Mr. Kleinman and Mr. A. C. Dougall. The superintendent of the factory is Mr. Chas. Franke, who is himself a thorough mechanic. His experience in the manufacture of electrical goods dates from almost the inception of the industry.

Jones Continuous Station Switch.

A very serviceable device for central stations is shown in the accompanying cut. It was designed by Mr. C. E. Jones, of Jones Bros. Electric Company, Cincinnati, O. The object of the device is clearly shown by the cut. Central station men are well aware that the blowing of a fuse often leaves the customers without light for a considerable time. The extra fuse cannot be found, the building posts for some reason refuse to release the parts of the old fuse and the delay is many times longer than such a simple operation would seem to cause. By this device, not only one, but two extra fuses are always in place and are thrown into the circuit by a short pull on the chain. Pivoted in the center of the three-point switch is the binding post for one contact. The ratchet on the lever fits into the cogs on the surface of the central disc. On the opposite end of the lever to that to which the chain is attached is a weight which, when the chain is released, throws the lever back to its original position.



JONES CONTINUOUS STATION SWITCH.

This central disc through one of three arms makes contact with one of the three spring contacts on the upper part of the device; each one of these contacts connect through a fuse with the outside circuit. If the switch is placed so that switch No. 1 is in circuit, on that fuse blowing out the attendant pulls the lever and fuse No. 2 is thrown in circuit, allowing a new fuse to be placed in No. 1. If fuse No. 2 should be blown, the attendant throws in fuse No. 3. The switch is substantially made, mounted on a marble base and the different fuse strips protected from the blowing of its neighbor by fibrous partitions. One size of the switch will carry from 50 to 125 amperes and another from 122 to 250 amperes. These switches have been satisfactorily used in the central station at Cincinnati and other stations are adopting them.

The Waterhouse Meter.

A new meter for measuring electricity has recently been brought out in England. It gives very good satisfaction, being reliable and giving a direct reading. Its use is limited to direct current circuits. While it belongs to the electrolytic class of meters it differs widely from any previously brought out. The current passes through the meter on a shunt, a resistance being interposed in the mains so as to send a certain percentage of current through the meter. The meter really measures the gas formed by the decomposition of the electrolyte.

The meter is about 12½ inches high and is enclosed in a suitable case. The meter proper consists of an electrolytic cell through the bottom of which passes two platinum electrodes. Suspended over these electrodes by a rod in the electrolytic fluid is a glass bell of a standard size, from the upper part of which projects an inverted siphon. To the upper end of the rod there is fastened a rod by a hinge-joint which is pivoted on the axis of a gear wheel. The rod being moved up and down a ratchet on the lever turns the gear wheel, which in turn operates the ordinary recording device.

When the meter is in use the gas collects in the bell until it forces the fluid in the inverted siphon and escapes, the bell filling with the fluid. The gas again accumulates and the process is repeated. Of course, as the bell fills with gas it becomes lighter and rises, and when the gas escapes it sinks, thus raising and lowering the rod, which turns the racket wheel a certain distance.

The resistance of the cell is small, only about two volts, so that resistance must be placed in the shunt circuit as the difference of potential demands. The electrolyte is a 12 per cent solution of sulphuric acid. The meter can be made very sensitive and will register through a wide range of varying loads. It is manufactured by the Waterhouse Electrometric Syndicate of London.

The New Vestibuled Train Service via Chicago & Grand Trunk, Grand Trunk and Lehigh Valley railways, between Chicago and New York and Philadelphia, via the famous St. Clair Tunnel, Niagara Falls and the beautiful Susquehanna, Wyoming and Lehigh valleys, known as the "Switzerland of America," offers elegant appointments and is the most picturesque route connecting these leading cities. Train leaves Dearborn station, Chicago, daily 3:10 P.M.

Iron Armored Insulating Conduit.

Among the recent improvements made by the Interior Conduit & Insulation Company in its now widely used system of wiring is the iron armor now made on the conduit. The plain and brass covered conduit have seemed to fill almost every case but in new buildings, where the danger to mechanical injury is great, it was found to be easily injured, especially when laid under the floor. This new conduit, however, with its iron sheathing cannot be so easily injured. It is but another evidence of the tendency of the times, to build as permanently and substantially as possible. More massive and enduring structures are being built and everything that enters their construction must be of like character.

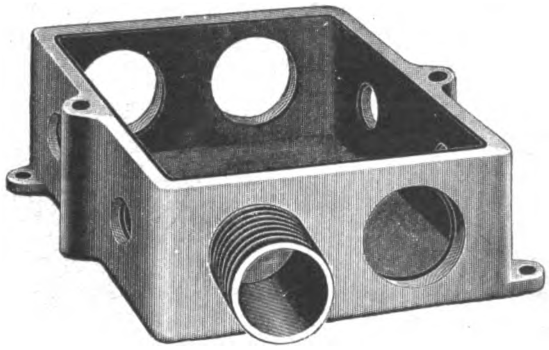


FIG. 1.—IRON ARMORED INSULATING CONDUIT.

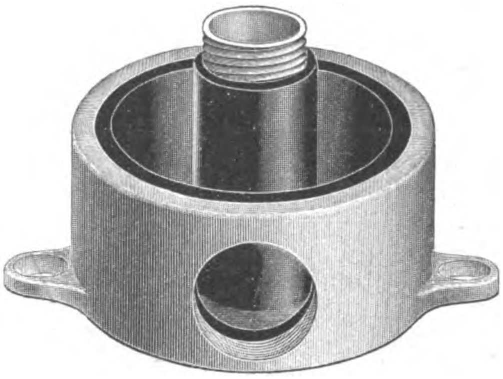
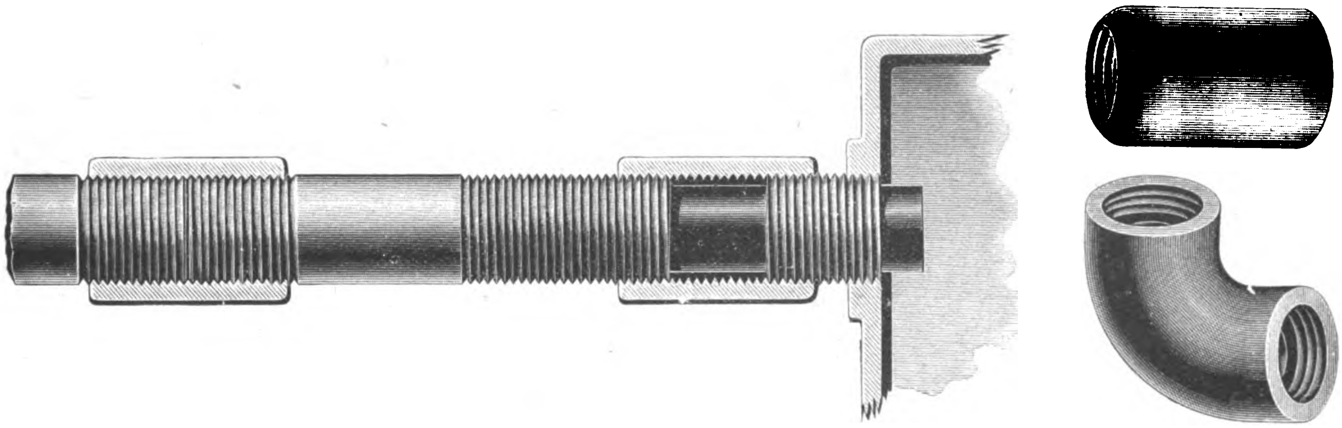


FIG. 2.—IRON ARMORED INSULATING CONDUIT.

Electrical construction of every kind has greatly changed during the past few years, and the methods of installation are assuming a more complete and regular form. Better methods are everywhere noticeable in electrical work. The time has passed when the loose and imperfect work that was formerly done will be accepted. Improvements of all kinds are readily adopted and encouragement is given to the use of better devices. The introduction of the interior conduit system marked a great advancement in interior wiring. Improvements have been gradually made as the needs and opportunities appeared. The connections and fittings of different patterns have been changed and altered to meet the requirements of different installations. The brass covered conduit greatly increased the usefulness of the system and permitted the system of wiring to be placed entirely in view in the older buildings or where the plans of architect or designer so demanded. Its increased strength for concealed work has also tended to extend its use.



FIGS. 3, 4 & 5.—IRON ARMORED INSULATING CONDUIT.

The armored conduit which has but recently been placed on the market, is but a stronger and more durably constructed conduit for the same system of wiring. A system installed with this conduit has the same flexibility of the former. It has the same high grade of insulation with an indestructible covering. The conduits with fittings, consists essentially of the plain insulating tubing placed within a heavy lap-seamed, wrought iron pipe which forms an armor of about one-eighth inch in thickness. The insulating tube and the armor are so closely united that they form a single tube, firm and inseparable. The junction and cut-out boxes are also metal covered and contain the same insulating qualities as those used with the plain conduit. This system has as complete a metallic covering as a gas or water system of distribution. It is so strong that it can be laid as a gas system, beneath the floors in concrete or in the walls of a building. The electrical installation can therefore be made early in the construction of the building, which will allow the work to be done oftentimes at a lower cost and in a more satisfactory manner.

The company has brought out with this conduit a complete set of tools for cutting, threading and putting it together. The threads are all straight so that the ends of lengths shall abut in the center of the coupling, maintaining a continuous insulation. The system will be practically water-tight and no trouble can be experienced from damp or wet circuits. This kind of conduit has already been specified for a number of buildings. Among those in the west is the new public library building of the city of Chicago located on Michigan avenue. This building will be one of the finest in the city and its electrical equipment will be of a kind that will correspond favorably with the rest of the building.

This new conduit will undoubtedly be widely used in future installations. Permanence and efficiency are two attributes most sought after. Easily injured and leaky circuits have been too numerous in the past and in the future owners will be more particular regarding their electrical equipments. The Central Electric Company, Chicago, which is the western agent of the manufacturers of this conduit, are ready to fill orders for complete equipments. Attention has already been called to the display of interior wiring at the company's salesrooms, which shows the great flexibility of the system and adaptation to light and power service.

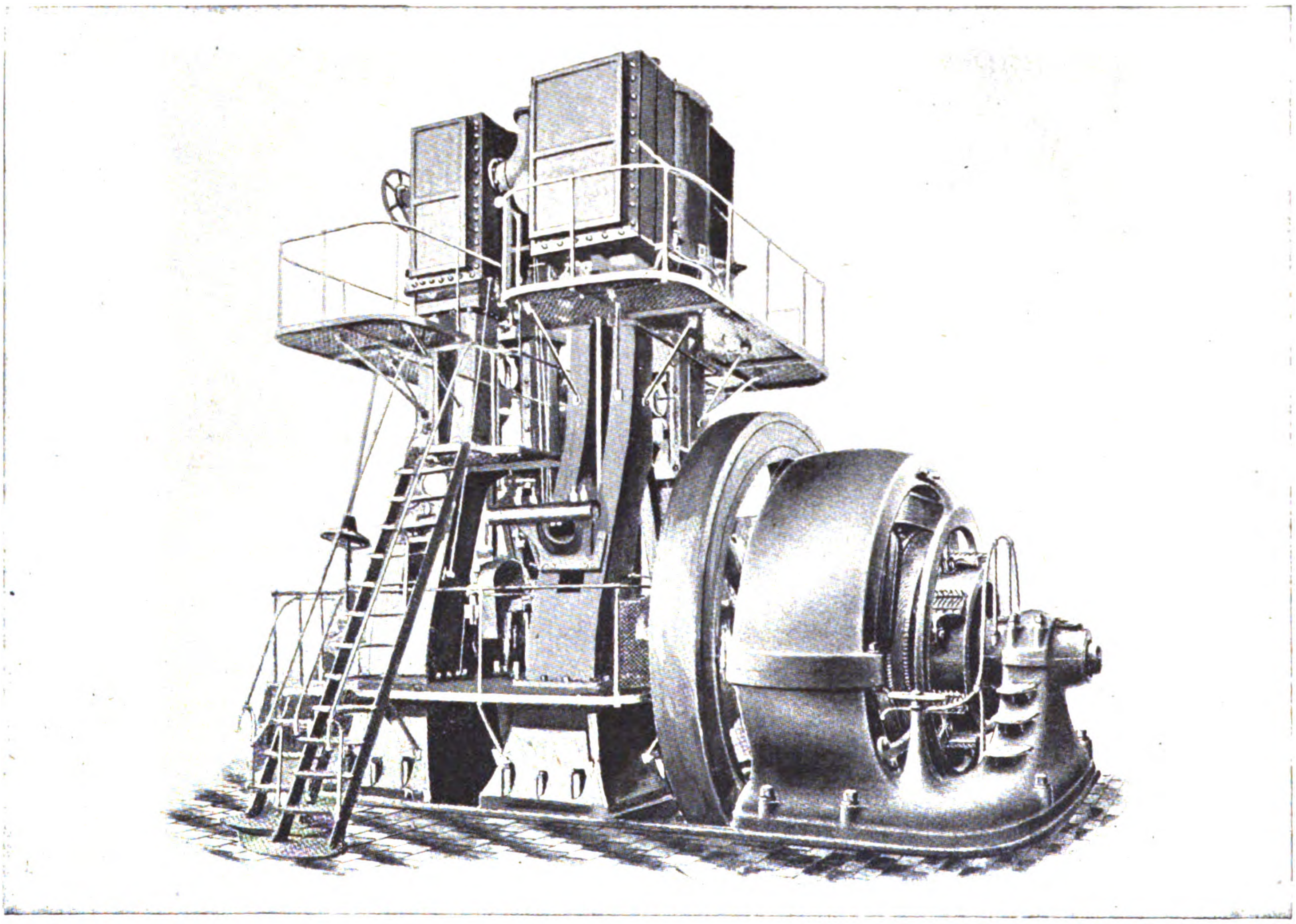
Direct Connected Generator of the Walker Manufacturing Company.

Only a few years ago the state of electrical engineering in general, and of dynamo design in particular, was such that any and all apparatus designed for commercial use was universally looked upon with suspicion as being something untried and experimental. And this was so with good reason since electric and magnetic phenomena were little understood and in consequence the design of machinery based thereon depended upon the use of empirical rules and formulae deduced from imperfect theories and experiments. Progress, however, has been very rapid, and today the magnetic and electrical principles underlying the construction of electrical machinery, particularly of the direct current type, are so well understood that apparatus of this class can now be turned out with an even greater degree of precision than is possible in many other much older lines of engineering.

In placing upon the market a line of direct current generators, especially designed with a view to the very exacting requirements of railway work, it has been the aim of The Walker Manufacturing Company to avoid as fully as possible the introduction of novelties and untried features, and to produce a type of machine which should combine all the long-tried and well-proven elements of dynamo electric machinery that the best engineering experience could suggest. It is confidently believed that this aim has been accomplished and embodied in the apparatus now being put upon the market.

In general these machines are notable for their strength of design and high commercial efficiency. The frames, excepting the largest sizes, are cast in two pieces, the upper half of yoke and poles, and the lower half of same with the standards for the bearings. The armature is proportionally of large diameter, is of very low resistance with ample cooling surface, and will stand an overload of 50 per cent, without the least injury or sparking for as long a time as the emergencies of railway practice would ever be likely to demand. It is of the iron clad drum type, built up of the best quality of annealed armature iron. The plates are again annealed after being punched, and then insulated with a thin coating of enamel. They are compressed into a solid core under a hydraulic pressure of about 100 tons. The foucault and hysteresis losses are reduced to a very small amount.

In the smaller machines, the windings consist of heavy copper wires so arranged that no wires cross within an inch of one another, and there are no joints except at the commutator bars. In the larger generators, flat bars are used, but here again they are bent to shape before being applied in such manner than there are no joints except at the com-



DIRECT CONNECTED GENERATOR OF THE WALKER MANUFACTURING COMPANY.

mutator end. The resistance being very low, the heat loss is small and the armature runs cool under all conditions. The winding is the 2-path type, and the pole shoes and armature teeth are so shaped that there is absolutely no sparking at any load and no shifting of the brushes required.

The insulation is most thorough, and will readily stand many times the normal pressure. The insulating material is a combination of mica, with a fibrous material of great toughness and durability, and it is everywhere tested to 5,000 volts alternating. This type of winding lends itself admirably to the most perfect insulation. The armature body is strongly keyed to a heavy cast center, and is so constructed that when running, both it and the armature have a strong current of air circulating through them. The teeth are of such shape that they effectively hold the windings in place, and no binding wires are required or used.

The magnets are of the well-known iron clad type. The coils are machine wound, the shunt and series being made up in separate independent bobbins, and encased in the same manner as the motor coils, with a moisture proof covering. This method renders the insulation especially effective and durable, as there are no metallic washers or spools which are difficult to insulate properly. The coils are held firmly in position by means of brackets bolted to the pole pieces.

The poles are made of soft laminated iron cast into the yoke. With this laminated form of construction, together with the particular form given the armature tooth, and the special shape of the polar face, adopted after much experimenting as being the most effective, all heating of the poles from eddy currents in the iron and all sparking and shifting of the neutral point has been entirely overcome. These railway generators are compound wound, and can be made to over compound any amount desired up to 20 per cent. They are provided with a hand regulator for adjusting the shunt coil, this regulator being of the well-known enamel type, occupying a very small amount of space on the switch-board. The bearings are of the ball and socket self-oiling type. Sight guages indicating the oil level are provided.

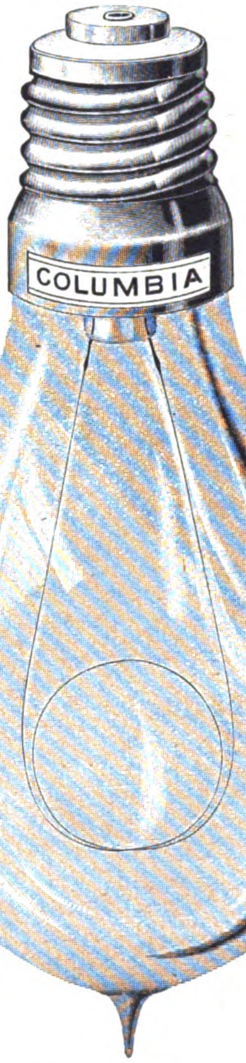
The subject of brushes and brush-holders, has received very careful attention in the design of these machines. The brushes are held against the commutator in a manner that prevents the chattering and singing noise of the carbons, and causes them to wear smoothly and evenly. They may be easily and quickly removed for inspection, or dressing. The commutator is large enough to allow of ample brush area, thus permitting the brushes to run with a low current density and with a light tension. Coolness in running is in this way assured, and this feature is also aided by the current of air which constantly circulates through the interior of the commutator shell.

The field and armature cables are brought out to heavy, substantial terminal blocks and massive clamps are provided for by the switch-board loads. The pulleys provided for the smaller belt-driven machines are very heavy and strong, and a sub-base is provided with belt tightening mechanism.

At Rochester, N. Y., 150 cars of the Rochester Railway Company are being fitted with fenders. Life guards and fenders are in many cities now considered necessary parts of the equipment of electric cars. The subject is being agitated in other cities.

The Columbia High Economy Incandescent Lamp.

The incandescent lamps manufactured by the Columbia Incandescent Lamp Company have been extensively used for several years. Improvements have been made in this lamp as experiments have shown the value of them to the consumer. These experiments, conducted under the supervision of Mr. J. E. Randall, have been most beneficial in their results. The efficiency and durability of the lamp have been increased and new methods of manufacture have reduced the cost of manufacture. The advancement made recently in this direction seems to indicate that the time is drawing near when "incandescent lamps can be purchased as easily as a sack of flour or a pound of sugar." Their use is more rapidly extending, as their price, with that of electrical apparatus, is reduced.



THE COLUMBIA HIGH ECONOMY INCANDESCENT LAMP.

Good lamps will always find customers while poor lamps will be dear at any price. In the high efficiency lamp recently placed on the market by the Columbia company a superior lamp has been perfected. It is made for 100 and 110-volt circuits. The filament is made by an entirely new process which enables them to be manufactured in quantity of uniform quality. The lamp is given a high economy. The filament is made in a coiled form on account of its extreme length, and while this is not the special feature of the lamp it increases the steadiness of the filament and concentrates the light in a smaller space. The company asserts that the use of this lamp will show a saving of from 15 to 20 per cent and give a station an additional output. The lamps are packed in the usual quantities for shipment.

The Standard Transformers.

In connection with the line of alternating current apparatus recently designed and placed on the market and which is admirably illustrated in the new catalogue of the Standard Electric Company, an excellent transformer is manufactured. The accompanying cuts show to good advantage the general outlines of these transformers. The transformer occupies a most important position in every alternating current system of distribution and in accordance with the efficiency of the transformers the efficiency of the entire system must be estimated. This fact has been fully appreciated in the design of these transformers and its durability as well as efficiency has not been overlooked.

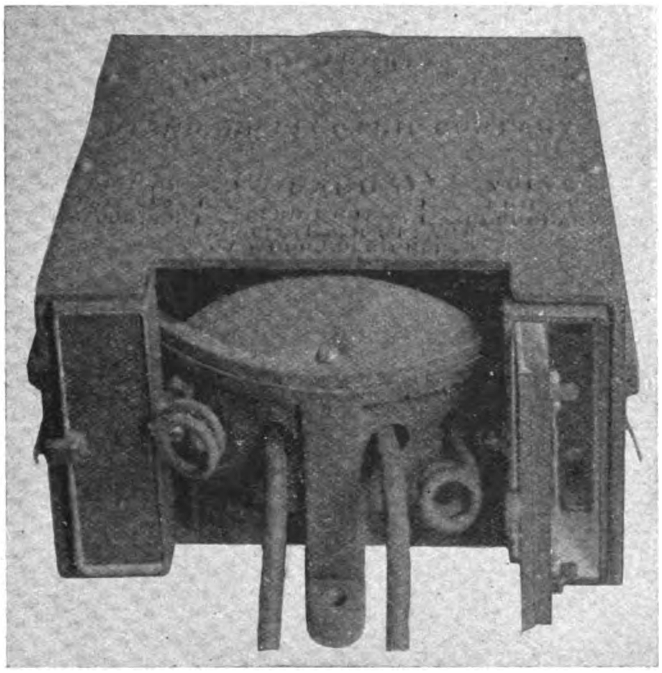


FIG. 1.—THE STANDARD TRANSFORMERS.

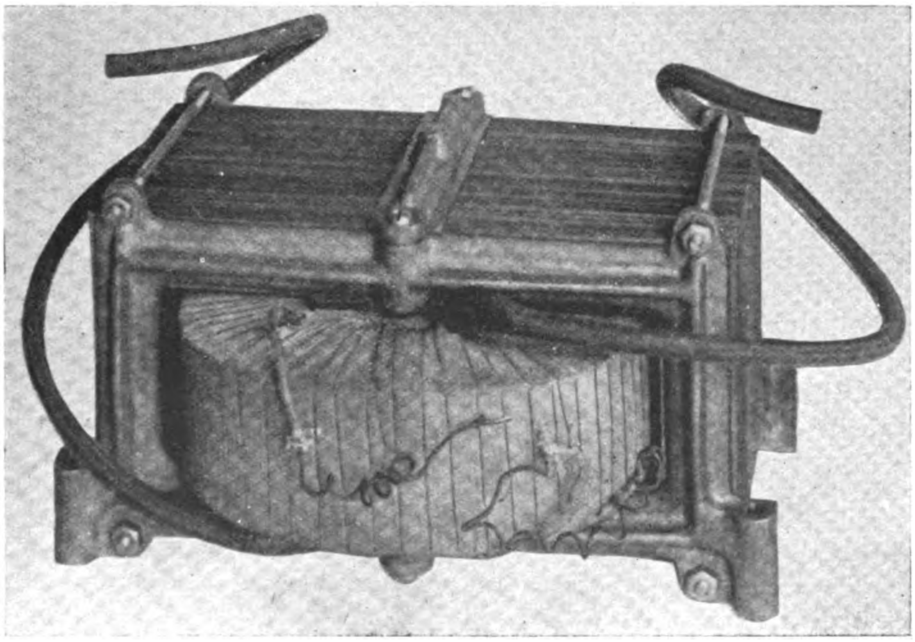


FIG. 3.—THE STANDARD TRANSFORMERS.

The cores are built up of special rolled steel, the sections being fastened together in a careful and substantial manner. The construction is such and the joints are so distributed that leakage is reduced to a minimum. The copper of the transformer is based on a current density of 1,000 amperes per square inch and the ohmic loss in no case exceeds one and one half per cent of total watt output. The resistance is tested in both coils, and transformers of the same size do not vary over one per cent in these resistances. Before leaving the factory the transformers are given severe tests. First, a full load test for five hours and then a 20 per cent over load for five hours. During the latter test the secondary terminals are twice short circuited, allowing the fuses to explode. An insulation test is made with less current between the primary and secondary coils and between both coils and the iron case with a voltage twice that at which the transformer is intended for.

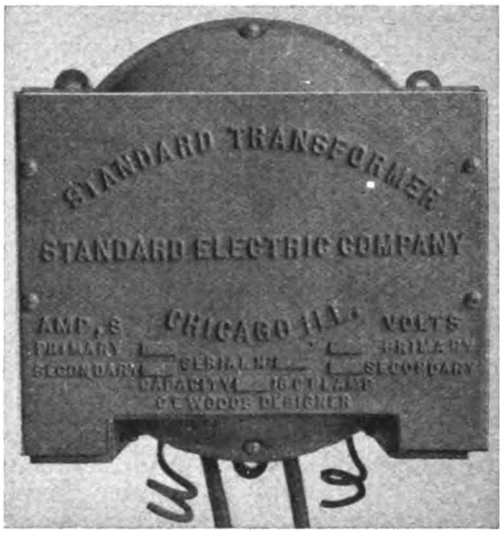


FIG. 2.—THE STANDARD TRANSFORMERS.

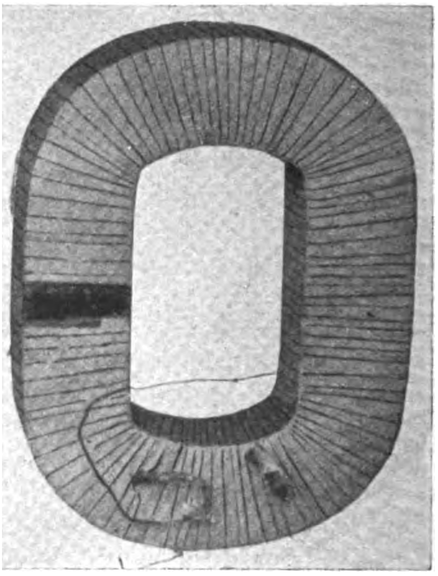


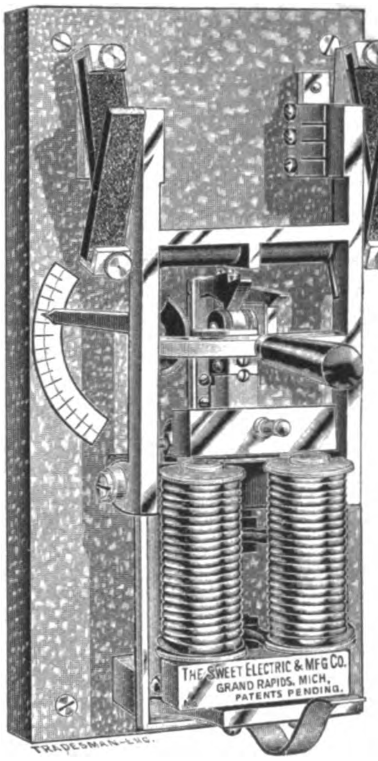
FIG. 4.—THE STANDARD TRANSFORMERS.

One of the special features of the transformer is the fusing devices. Both fuses of the primary are not, as is usually the case, enveloped in the same chamber, but are supplied with separate chambers which are lined throughout with porcelain. The terminals are mounted on slate. This form of construction prevents the current arcing to the iron case as would occur with a different construction. The coils are supported in case by bolts fastened in each corner. In re-fusing the transformer the fuse terminals, which are on the inside of the fuse chamber, are removed entirely from the case, enabling the operator to insert a new fuse without danger to himself or to the apparatus. It requires but an instant to insert a new fuse. The terminals of both the primary and secondary coils are brought out on the underside of the case through waterproof outlets and the primary wires do not lead directly into the fuse chambers, a method obviating the necessity of water loops.

The heating of the transformer under full load never exceeds 150 degrees and the regulation in all sizes is within two and one half per cent. The guaranteed efficiency is in no case less than 95½ per cent and in the large sizes is as high as 96.6 per cent. These transformers are made in all sizes and voltages demanded by the American market. The cases are finished in a waterproof preparation and are supported by three lugs with lag screws or straps to go over cross arms.

The Sweet Limit Switch.

The accompanying illustration shows a device to take the place of fuse wires in electrical installations. As is well known fuse wires are not always reliable, and a demand for a more sensitive protecting device has led the manufacturers to place this limit switch, as it is called, on the market. The device has been constructed in accordance with well-known principles. The makers claim an action as positive and reliable as that of an amperemeter, which indicates the rate of current continuously, while this switch indicates when the rate of current has reached a certain point by opening the switch. The design, both electrically and mechanically, is considered excellent.

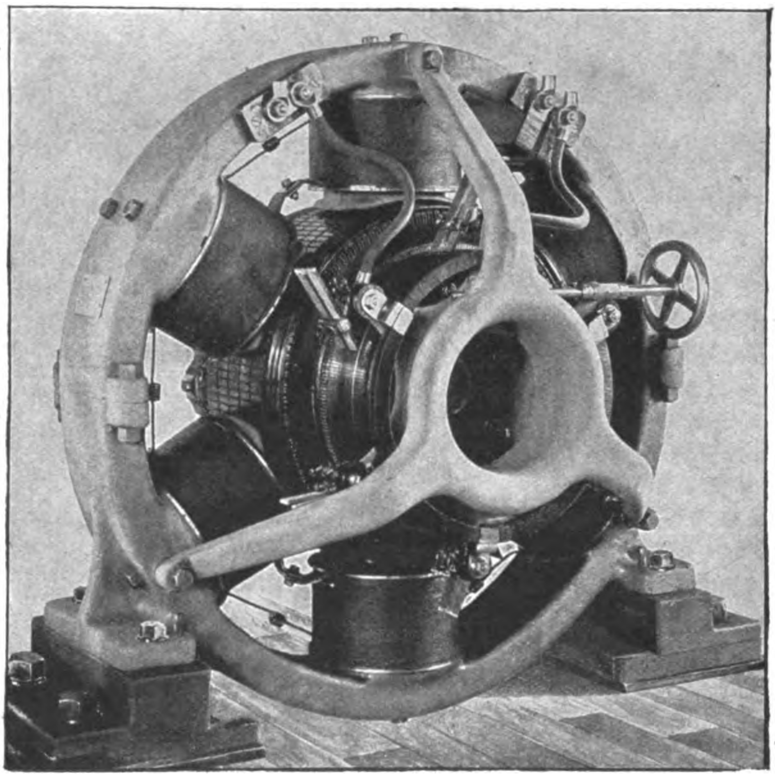


THE SWEET LIMIT SWITCH.

They are made for use in all pressures—from one-quarter of one volt to 10,000 volts if required. The breaking of the circuit is between carbons in such a manner that when the metal contact is broken the contact is made on carbons, which are rotating, throwing in a resistance that before breaking the final point of contact, the volume is greatly reduced, and the arc broken, leaving no possible chance to carbonize the air, as the motion is very rapid.

The sensitiveness of the machine is in its mechanical and electrical construction. It has two coils from which the arms swing above the centers, and the locking and opening of the machine is attached to a fibre suspension directly attached to the amature with a steel roller which follows over a steel plate cut in such shape that when the armature begins to move the roller in passing over the projected steel plate, the force of the suspended arm is increasing rapidly, and the unlocking of the lever takes place with this force, and as soon as unlatched the rotating carbons with their outward pressure which is given them by springs attached, makes the opening of the machine positive in every detail, so positive and delicate in its adjustment that in the larger sizes, 200 to 700 amperes capacity, the device will open on less than one-quarter of one ampere over and above its set capacity, and in the smaller sizes—one-half to 200 amperes—on less than one-twentieth of one ampere.

This machine is adapted to all electrical currents, stationary and isolated plants, stationary motors, dynamos and for house wiring, also a pattern especially for street car motors. The Sweet Electric & Manufacturing Company, of Grand Rapids, Mich., conduct the manufacture and sale of this switch, and have already met with flattering success in placing the same on the market.



NEW TYPE OF DIRECT CONNECTED GENERATOR.

New Type of Direct Connected Generator.

The accompanying illustration shows a new type of direct connected generator, manufactured by the General Electric Company. This type has been furnished on a number of recent orders. The entire frame of the machine is available for magnetic purposes. The magnetic circuits are shortened and a greater output is obtained from a given weight and speed. The shape of the machine allows a great saving in station space.

The frames and pole pieces are cast from a special soft steel of very high magnetic permeability, and the construction of the armatures is such that a constant current of air circulates through the core and windings, and provides the necessary ventilation. The armature windings consist of straight copper bars so connected as to render short circuits or similar troubles practically impossible. The insulation is built up of alternate laminations of tough paper and sheet mica, joining high spark resisting qualities with great mechanical strength and durability. The machines are designed for very small rise in temperature at full load, the limit on the standard machines being only 40 centigrade above the surrounding air after a continuous run of ten hours, while in the dynamos constructed for the U. S. Government the limit is reduced to 28 centigrade.

The General Electric Company's multipolar generators are divided into two classes, the "smooth body" and the "iron clad," the distinction lying in the construction of the armatures, the field frame remaining the same, with, of course, the number of poles differing with the capacity of the generator. The smooth body armature is used for the larger, and the iron clad for the smaller sizes. In the smooth body armature the bars are separated from each other, and the constant circulation of air and the large surface area, render the armature remarkably cool running. The bars connecting the inner and outer winding, form the commutator, and as they are an integral part of the winding, the extra resistance from connecting leads, contact surfaces, an important consideration in large machines, is eliminated. Each of these armatures has practically two commutators, one on each side, so that when one has worn down, the armature may be turned around and a new commutator be presented to the brushes, which are all in view of the dynamo attendant from the floor of the engine room. These machines are sparkless.

The iron clad armature derives its name from the manner in which the core is slotted. When the conductors are placed in the slots they become practically embedded in the body, and thus the iron of the armature being brought closer to the pole pieces, the reluctance of the magnetic circuit is reduced and the capacity for a given weight increased. The copper, when placed in these slots, is not penetrated with magnetic lines, the total flux passing through the teeth. Large solid copper bars may be consequently best used as conductors without loss from eddy currents, and the armature winding becomes a simple mechanical structure. The ventilation, insulation and facility of repair are of similar excellence to those of the smooth body type. The commutators are bolted directly to the body, and a flexible strip connects the sections of the windings with the commutator's bars.

On the larger sizes, the clamping ring holding the commutator bars, is made in sections. This allows of all the bars to be held in place with rigidity, and in case of a cross, or burn out of insulation between the bars, only a comparatively small section of the commutator need be disturbed to remedy the effect. The brush holders are all mounted on a spider or rocker arm, and may be all moved simultaneously by means of hand wheels. The brushes are of woven metal gauze.

These multipolor generators are made in sizes ranging from 25 K.W. to 800 K.W., and for speeds ranging from 300 revolutions in the smallest to 90 revolutions in the largest. They may be run at other speeds, giving, of course, a change from the normal voltage. At any speed the voltage of the generator may be raised 50 per cent and lowered 10 per cent from the normal value which corresponds to this speeds without impairing the satisfactory operation of the machine.

These machines may be connected directly to horizontal engines of the Corliss type or vertical engines of the Marine type, triple or quadruple compound. The smaller sizes may also be connected to engines of the high speed type.

Specialties of the Metropolitan Electric Company.

The accompanying cuts show a span wire insulator and a Lowell lag-screw wrench which are handled by the Metropolitan Electric Company, Chicago. This insulator, Fig. 1, is designed for insulating span wires on overhead construction of electrical railways. It is also well adapted for suspending arc lamps or other work where a strong, durable insulator is desired. As a circuit breaker on electric lines it possesses the necessary qualities. The ball is made of tough green glass. It is three inches in diameter and has two grooves running part way around it at right angles to each other. Loops of seven-stranded steel wire, which have previously been dipped in P. & B. insulating compound, pass around these grooves. Perfect insulation is assured. A malleable iron casting is fastened to the end of each loop to which the span or other wire is attached. It is said this insulator will stand a strain of 6,000 pounds and that the most severe changes of weather do not affect its insulation. The practical use of this device has shown its utility under the varying conditions of weather and service.

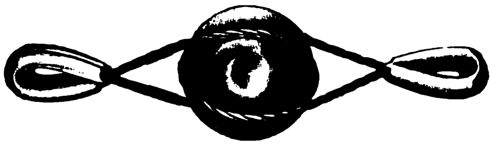


FIG. 1.—SPECIALTIES OF THE METROPOLITAN ELECTRIC COMPANY.

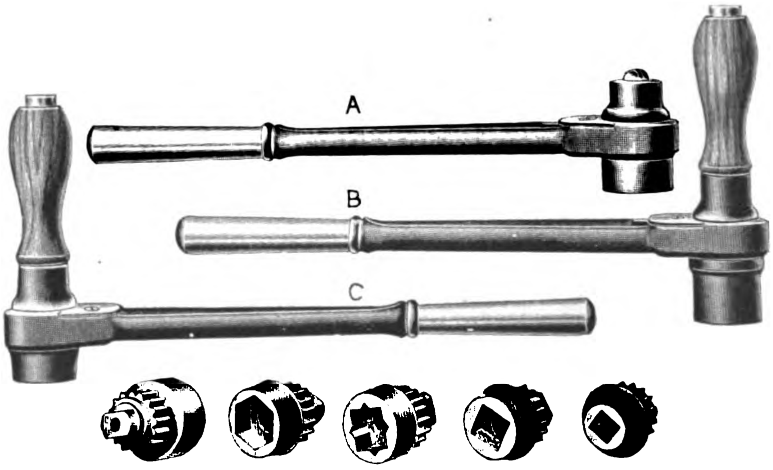
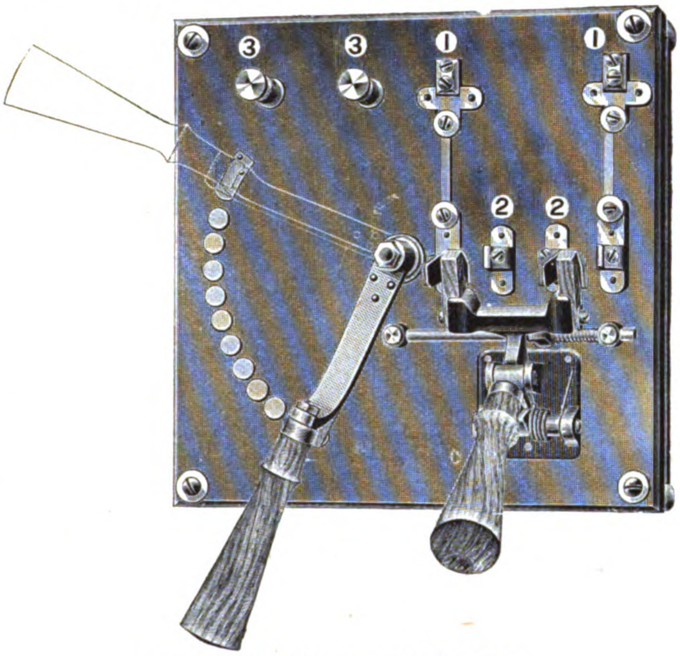


FIG. 2.—SPECIALTIES OF THE METROPOLITAN ELECTRIC COMPANY.

In Fig. 2 is shown the Lowel lag screw wrench. Its usefulness, especially in line construction, is at once apparent. For telephone and telegraph work as well as for all overhead construction this is a most important tool. In fastening the cross-arm to the standing pole this wrench is a handy tool. The insecurity of the footing gives the hands and arms of the workman but partial liberty but sufficient to use this tool advantageously. Different sockets fitting screws of different sizes can be quickly inserted or removed. The wrench is strongly made and very simple. It is used extensively by fire alarm and telegraph constructors. Workmen with this wrench are more apt to turn the screw in than to drive it and better work is therefore secured.

Self-Locking Switch and Rheostat.

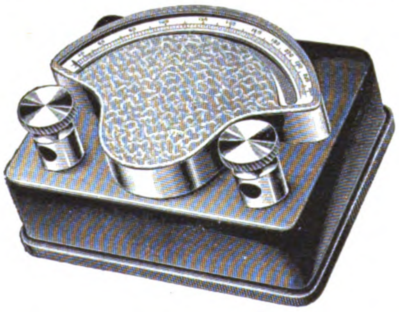
The accompanying cut shows a very compact as well as efficient combination. It shows a self locking switch and rheostat mounted on one base which is in itself an improvement over the usual method of mounting separately. One of the chief advantages, however, is the self-locking device which prevents the switch being closed except when the resistance is all in. Fuses are blown, or the armature of the motor is often burned out through carelessness by the full current being suddenly turned on the motor. This combination effectually prevents any such accidents and is another step in the perfection of electrical power machinery. Motors are generally installed in places where they are in charge of unskilled men who are not always careful in the use of electrical machines. This motor starting device is manufactured by the W. S. Hill Electric Company of Boston, Mass., which makes a specialty of switchboard apparatus. The boards show the usual skill of this company's goods and is well made throughout.



SELF-LOCKING SWITCH AND RHEOSTAT.

Portable Alternating Current Meter.

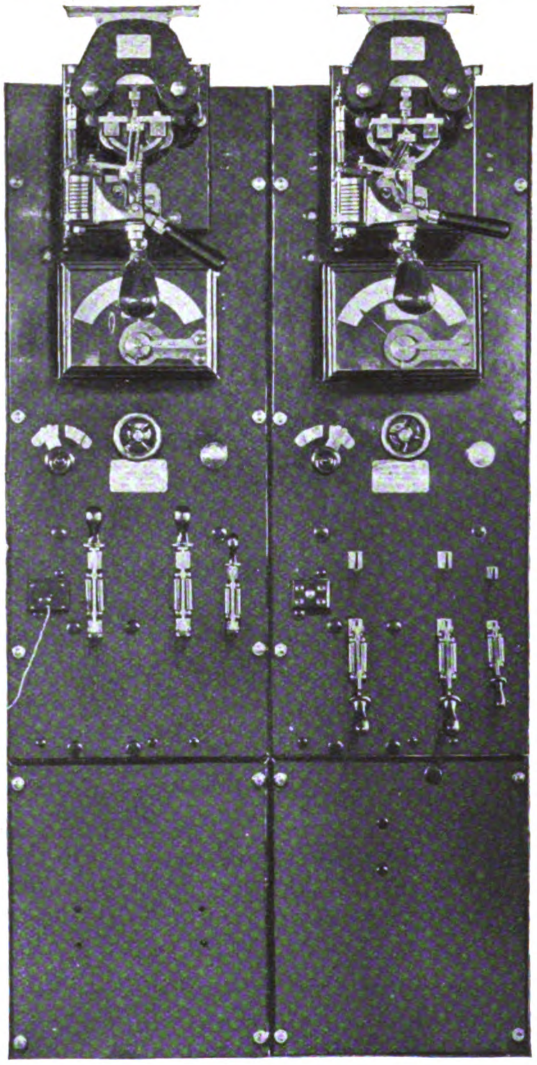
In the manufacture of electrical measuring instruments greater accuracy is being attained in the commercial instruments, and sizes better suited to the needs of the electrical engineer and attendant are being made. While their value electrically is being increased the mechanical construction and mounting is improved. The portable instruments have received considerable attention and are now made in any sizes desired and of convenient shape for carrying. The General Electric Company has placed on the market a portable alternating current meter of the design shown in the accompanying cut. It is small, strong and handy to carry. It is of a compact form and reliable. The workmanship displayed is excellent. The scale is long and reads to fine divisions. The instrument is designed for alternating current work, but can be used on direct current circuits. When used on direct current lines it requires special calibration. The sizes were determined upon after conversation with engineers of long experience. The range of sizes is from 25 to 200 amperes and covers all that could be desired. Thus 25, 50, 100 and 200 ampere sizes are manufactured. Before leaving the factory every instrument is carefully calibrated and tested so that every instrument that leaves the factory is reliable.



PORTABLE ALTERNATING CURRENT METER.

Railway Switchboard Panels.

The accompanying cut shows the general design of switchboard panels for electric railway power plants which are manufactured by the General Electric Company. These new standard panels are known as type "K" and are constructed in capacities of from 200 to 3,000 amperes corresponding to the generator outputs of from 100 to 1,500 kilowatts. The controlling devices mounted upon each panel are the circuit breaker, current indicator, rheostat, main, field, and lightning switches, together with the lightning arrester and cut-outs required for the protection of generator and instruments. A double pole plug switch allows of connection with either a portable or station voltmeter placed in some convenient position. The panels of from 200 to 1,000 ampere capacity are of the same width and height, and, in the latter dimension, are similar to the feeder panel. The illustration shows two panels of 400 amperes each.



RAILWAY SWITCHBOARD PANELS.

A BRIEF REVIEW.

FROM ALTERNATING TO DIRECT CURRENT.

One of the important problems that have engaged the attention of electrical engineers during the past few years, has been the transformation of alternating currents into continuous currents. The Americans have done practically nothing in this direction; the French have done a little, in the persons of MM. Hutin and Leblanc; but the Germans have carried this principle from an experimental to a practical stage. Associated with other workers in Germany have been Messrs. Lahmeyer and Pollak, and there are now several installations in actual operation in that country and in Switzerland where continuous currents obtained from alternating are employed. Notwithstanding this fact, many people in England have hitherto doubted the practicability of the devices used to convert the one into the other form of current. However this may be, the central electric-light station started last week in Portsmouth shows, as far as experience there has gone, that this method is a success. The generating plant at this station has been experimentally worked for several weeks, and was formally set in operation on Wednesday of last week, in the presence of a large gathering from nearly all parts of the kingdom. The plant has various novel features deserving of brief mention. There are five Lancashire boilers supplying steam at 140 lbs. Probably the most interesting feature of the station is the engines and alternators, which may be termed fly-wheel alternators, since the alternators are not coupled to the engines, but form an integral portion of them. The engines are of the usual coupled compound type—namely, the high and low-pressure cylinders are arranged one at each end of the crankshaft, the fly-wheel being in the center and having on its periphery the field magnets, which revolve inside the stationary armature. The frame containing the armature sections is carried round the fly-wheel. There are two sets of fly-wheel alternators, which are excited by direct-current dynamos driven by ropes off pulleys on the engine crankshaft. Each alternator has a capacity of 212 kilowatts, the pressure being 2,100 volts and the speed 96 revolutions. Running in conjunction with these combinations is a turbo-alternator giving 150 kilowatts at 3,000 revolutions. Passing from these generators the current is led to a main switchboard equipped with elaborate switching gear, and where every arrangement has been made for parallel running. The system of supply for private lighting is by underground mains to transformer boxes arranged in different parts of the town, where the current is reduced and distributed in a low-pressure two-wire system; whilst for public street illumination high-tension arc-lighting mains, connecting the arc lamps in series of about forty each, have been laid down. These latter lamps are supplied with rectified currents—that is, by the alternating current converted into a direct current by the use of Ferranti "motor commutators," or, more properly speaking, rectifiers. The rectifier comprises a synchronous, self-starting alternating-current motor, provided with a commutator for rectifying the current necessary to excite its own field magnets, and equipped with two other commutators—one at each end of the motor—for the purpose of rectifying the current for the street arc lamps. The current furnished to these commutators is passed through constant current converters. At the present time there are 100 arc lamps lighting the principal streets of Portsmouth and Southsea, and each lamp standard is equipped with a 32 c. p. lamp, which is brought into use at midnight when the arc lamps are extinguished. The working of the station on such novel lines will be watched with interest by all concerned in the development of the applications of electricity.—*Mechanical World.*

POWER TRANSMISSION AT THE PARIS EXPOSITION OF 1900.

France has gone through the agonies of a poignant grief during the past week, but her calmness and quick readjustment to normal conditions have once more evoked the admiration of the civilized world. Today her government and her internal and external relations continue as smoothly as though her Chief Executive had not been stricken down by the assassin's knife, and it might even be said that the courage and spirit of the nation had been bettered by the sharp ordeal.

The late President Carnot was a civil engineer, whose courtesies many of our American brethren remember, and the nature of his profession inclined him to the methods and triumphs of peace. It was for this reason that he took so deep an interest in the Paris Exposition of 1900, and that during his last year of office the plans for it had been pushed so far forward. At the present juncture, amidst the excitement caused by his untimely death, it is a pleasant relief to turn to the reports of the meeting of the Exposition Commission, which has just taken place, and to learn that a general programme has already been drawn up, in which, naturally, electricity has a prominent place. But what is of greatest interest is the list already submitted of plans for special features of attraction. It will be remembered that the Chicago World's Fair was heralded by a great variety of engineering schemes and ideas of an unusual character, most of which died away in early oblivion, one or two of which were dismal failures, and one of which —the Ferris Wheel—was a pronounced success in all respects. We note among the plans for Paris, a proposition of merit from M. Armengaud, jr., who, pointing out that previous expositions had been signalized by the exploitation of the telephone and the electric light, asks that in 1900 prizes of value be offered for three things, viz. (1.) Seeing at a distance; (2.) Photography in colors on paper; (3.) Electric light without heat. It will be admitted that all these three things, accomplished practically, would add greatly to the éclat of the Exposition; and the actual success already attained along each line affords encouragement. M. Trouvé, ever fertile and ready, has also suggested an electric light cascade falling from the third platform of the Eiffel Tower. It would certainly be a brilliant night spectacle.

We venture, however, to propose a scheme, of which we have seen no note thus far, but which would certainly interest not only all classes of engineers, but all concerned in railways, and the public at large. It is a familiar fact that among the most pressing problems of the day are those that relate to the electrical transmission of energy, and that at this hour some most important work is being done. Up to this time, however, the energy transmitted has been that of waterfalls, and all the plants under construction, such as that for Niagara, deal with water power. Now, a great deal has been said about burning the coal at the mine and transmitting its energy electrically instead of the fuel itself; and in England two well-known engineers, Messrs. B. H. Thwaite and James Swinburne, have worked out carefully the details of an electrical transmission to London of the energy of the coal fields of the Midlands and Yorkshire. What we propose is that the Paris Exposi tion shall, in like manner, have all its power generated at coal mines now supplying Paris, and that this power shall be transmitted electrically.

The Chicago Fair made no demonstration of this kind. In fact, none has ever yet been made. The nearest approach to it was the remarkable water-power transmission of 100 miles, under the patronage of the Emperor of Germany, from Lauffen to the Frankfort Electrical Exhibition in 1891. Some idea of what is involved as to expense may be formed from the Thwaite-Swinburne plan of a 100 miles transmission of 10,000-h. p. of energy from coal, at a cost not to exceed, all told, £340,000; on which basis, according to Mr. C. E. L. Brown, small users of power in London could get 1-h. p. per annum for $20. This plan contemplated the use of large gas engines at the generating points and a line potential of 30,000 volts. It is evident that all the apparatus, including line, would have considerable value after the close of the exposition. The Chicago plant for power reached about 20,000-h. p., and it is not likely that Paris would much exceed, if it equalled, this; so that taking the figures already cited, the initial total cost would not exceed £680,000 or $3,400,000, and the investment in gas engines, generators, transformers and motors would certainly be a largely recoverable quantity, to say nothing of the value of the copper in the line, costing about $500,000. Indeed if the demonstration proved successful, the plant could be left intact for the daily supply of power to the various large and small industries of the city, it being safe to assume that such a quantity could very easily be marketed. We have no data at hand as to cost of power in Paris, but it is probable that the ordinary selling price of 1-h. p. is not below $40 or $50.

If such a plan as this be not carried out the Exposition will still have to be furnished with its power in some way, and if resort be made to the ordinary methods there would be required for the 20,000-h. p. a large outfit of coal sidings, boilers, engines, shafting, machinery rooms, etc. By 1900, such methods will seem more dirty and antiquated even than now, but it might not perhaps be a bad idea as a compromise, to divide the power plant into two contrasting 10,000-h. p. units, one long distance transmission and the other that of generation *in situ*. The longer, bolder plan is that which appeals more to the engineering imagination, and one in the execution of which the authorities of the Exposition would probably enjoy very hearty advice, assistance and co-operation from French electrical engineering concerns, as well as others in America, England, Switzerland and elsewhere. If it be resolved to stick to water power, possibly the Exposition might be run by energy from the little sister Republic of the Alps, although by 1900 we shall all know a good deal about the working of such a plan, from the results obtained with Niagara.—Electrical Engineer.

THE HERMITE SYSTEM OF TREATING SEWAGE.

Considerable interest has been manifested in England in the application of the Hermite system of electrolyzing sea water to the sanitation of towns. The system has been experimentally tested at Worthing, but only on a small scale. Doctor Kelly, the medical officer of health for Worthing, recently issued an unfavorable report of the results with the Hermite method in that town. It appears, however, that this report was premature, and the town council of Worthing did not adopt it. Dr. Kelly's conclusions were, moreover, entirely opposite to those of M. A. Piton, who reported favorably on the Hermite system to the municipal council of Brest. Another report on the recent experiments at Worthing has now been issued, dealing with both the chemical and bacteriological sides of the question. This document is lengthy and of considerable importance. It has been prepared by a special commission appointed by the proprietors of one of the principal medical journals, namely, the London Lancet. It will be unnecessary to enter into details concerning investigations made by this special commission both at Worthing and in the laboratory. The conclusions of the commission will be sufficient. They are briefly as follows:

The electrolyzed sea water, whilst exerting a specific disinfecting action on the organisms, appears at the same time to be used up and destroyed to a much less extent by the organic matter present than any other disinfectant. The commissioners are quite satisfied from their examination of the effluent that the pathogenic germs, such as those of typhoid fever and cholera, would be effectually dealt with, as the more resistant bacterium coli commune appears to be destroyed. A strength of between 0.50 and 0.60 gramme of chlorine per litre is all that the commission consider necessary to effect the proposed objects of this method of sewage treatment. The adoption of any mixed system in which the house water, even without the storm water, is allowed to enter the drum in which the sewage undergoes treatment must always be accompanied by this danger * * * that the object of the system may be rendered futile from the fact that we must rely wholly upon the care and judgment of the household for the addition of sufficient quantities of the antiseptics from the sink. The application of the solution to the watering of the streets does not require serious consideration. The question of the flushing of the drains requires, however, further investigation as, although the direct antiseptic action would probably be small, the deodorizing and cleansing effects might have some value, but this can only be decided by direct experiment. The application of the system to hospitals in the complete reform recommended by M. Hermite has much to be urged in its favor. The development of the Hermite system must be regarded as merely one of the signs of a distinct movement in sanitary science which for some time has been manifesting itself in other directions. - Electrical Review.

AIR IN FEED-WATER.

In a paper read in Germany on the rusting of boiler shells, the author concludes that the most serious cause is the introduction of air with the feed-water. If the feed-water enters the boiler near the low water level he concludes that it will soon be expelled with the steam, unless it has a chance to accumulate in pockets. Such pockets rust rapidly. The feeding, he advises, should be completed before stopping for the day, so that the water standing in the boiler over night shall be as free from air as practicable. Faulty construction, the author believes, is the frequent cause of internal rusting. For preventing rusting he recommends: First, whilst the boiler is working—(1) Removing air from the feed-water before it enters the boiler. (2) Removing air from the water whilst in the boiler, and preventing its accumulation in pockets, etc. (3) Addition of chemicals to the feed water. (4) Protective coatings applied to the inside of the shell. Second, whilst the boiler is standing idle—(1) Removing all moisture from the boiler, (*a*) by blowing it off whilst hot, (*b*) by producing an air current through it, (*c*) by placing hygroscopic bodies inside. (2) Direct protection of the shells, (*a*) by painting with tar, varnish, etc., (*b*) by covering with protective paints, and such an alkaline coating as milk of lime. (3) Protecting the shells from varying temperatures by keeping the draught in the flues constant, and so as to prevent moisture alternately depositing and evaporating on the shell. (4) Protecting the shell by completely filling the boiler with water from which all air has been expelled.—Am. Machinist.

LARGE ELECTRIC TRANSMISSION IN NORWAY.

A syndicate has lately applied to the Norwegian government for a concession for an electric power transmission of some 20,000 horse-power from the Raanaas waterfall at Sörum and the Fossum waterfall at Askim, to the town of Christiania. It is understood that the plan of the installation is made by an English electrical engineer, and approved of by Lord Kelvin. It comprises the transmission of 20,000 horse-power to Christiania from the above two falls, but it is proposed to commence with a transmission of 10,000 horse-power. The tension is not to exceed 10,000 volts. The length of the line from the Fossum fall is close upon 25 miles; it passes through Spydelizerg, Tomter, Ski, and East Aker. The other, the Raanaas line, is about a couple of miles shorter, and passes through Sorum, Skedsmo, and East Aker. At the borders of the borough of Christiania it is intended to build a distribution station, where the high tension current will be transformed and distributed to the various parts of the town by means of underground cables, the proposed tension varying from 100 to 400 volts. The installation cannot only supply convenient and cheap power for the larger and smaller industries of the town, but it is also under contemplation to supply the whole town of Christiania—or at least the part of the same which is not lighted from the central electric station—with electric light at a cheap price. The lighting of the public thoroughfares will, according to the plan, be effected by arc lamps of 2,000 and 1,000 candle-power, according to the importance of the street, and the price will be much cheaper than that charged by the present central station. There will be several large turbines at each waterfall, which are some of the most important in Norway, and the high tension will be generated either direct or by transformers. It is proposed to use naked wires. The installation can, it is calculated, be completed in the year 1895, although much will depend upon the water level of the waterfalls, as the works in connection with leveling, damming, etc., require low water. The cost is calculated as 6,000,000 kr., or about 350,000*l*.—Engineering.

VESTIBULE LAW CONSTITUTIONAL.

It can scarcely be doubted that the time is not far distant when motormen and gripmen in all Northern cities will be protected from the cold during the winter months. Drivers of horse cars cannot expect protection of this kind from the very nature of the case, but their number is growing smaller with every month. In five states a law providing for the equipment of cars with vestibules is in effect, and although the measures have not in all instances met with the approval of the companies, they are now more inclined to view the matter philosophically, and are coming to the conclusion that the application of storm fronts may prove desirable after all. In the two instances in which courts have been called upon to pass upon vestibule laws they have affirmed their constitutionality, and have found that in compelling street railway companies to protect their men against the inclemencies of the weather, the state is not exceeding a proper exercise of its police powers. The Supreme Court of Minnesota has just declared that the law is valid, and has pronounced against all of the familiar grounds on which it was attacked. Most important of all of its findings is the affirmation that the law cannot be considered as class legislation. If such an act cannot be successfully assailed on that ground, there seems to be no reason for believing that it will fail of approval whenever its validity is question. No particular significance attaches to the finding of the court in Minnesota so far as that state is concerned, for the reason that while the law was attacked the companies decided to comply with its provisions; in fact, they went even further than they were required to do. According to the act they were compelled to vestibule only one-half their cars last winter, but before the close of the season almost all the cars in operation in Minneapolis and St. Paul at least were equipped. The decision of court, however, is of importance in that it will have the effect of aiding in the passage of similar legislation in other states. Motormen in several states are uniting in petitions to legislatures to pass vestibule laws, and now that the constitutionality of the measure has been again affirmed the lawmakers will be the more inclined to heed their requests. This being the case managers may as well make a virtue of necessity and prepare to add the desired storm fronts to their cars. They have been very bitterly opposed to the innovation in many quarters, not so much because they dreaded the expense, as for the reason that they were convinced that the protection would lead to an increase in accidents. So far as our knowledge extends this assumption is not proved to be correct by experience. The men who have tried the vestibules where they were honestly made tell a very different story. They assert very positively that with good vestibules the liability to accident is much lessened in severe weather, for the simple reason that the trainmen are better able to control their cars when comfortable than when chilled to the bone. It seems to be the fact that whether desired by companies or not the vestibule is bound to be adopted more and more generally, for the men are demanding it, legislatures are seemingly inclined to pass the necessary laws, and courts do not hesitate to approve them.—Street Railway Gazette.

THE COLOR OF THE ELECTRIC ARC LIGHT.

Prof. J. A. Fleming has shown that the well-known color of the light of the electric arc from the carbon points is due to the incandescence of the carbon filling the space between the positive and negative rods. The true arc is here, and exists in a space filled with the vapor of carbon, which has a brilliant violet color. Examined by the spectroscope, the central axis of the carbon arc gives a spectrum marked by two bright violet bands. Outside this is an an aureole of carbon vapor of yellow or golden color. The electrical strain of the arc occurs chiefly at the surface of the crater which forms at the end of the positive rod, where, in fact, the principal work of generating light is done; for 80 per cent of the total light of the arc comes from the incandescent carbon at this place. Thus, in a sense, the arc light is mainly an incandescent light; the effect being produced by the layer of carbon which is being constantly evaporated at an extremely elevated temperature. Hence the light of the carbon arc is not, and can never be, white, as it is sometimes described as being, but must always be tinted violet by the carbon vapor normally present between the rods.

"Electricity at the World's Columbian Exposition."

By J. P. Barrett.

Prof. Barrett says in the preface to his account of "Electricity at the World's Fair," that he has made no pretense to covering all the details of the electrical exhibits. He has taken only those he deemed of sufficient importance to justify them being considered, and many of these he has contented himself with briefly describing without comment.

As might be expected from Prof. Barrett, the book is a "plain unvarnished tale," of the electrical side of the great exposition. It is divided into 27 chapters covering the classes of electrical apparatus that entered into the exhibition. The account of the engineering features and construction for the service of the Fair is very full and will be of great value to the electrical fraternity. No division is made between the exhibits proper, and the engineering and service work. All incandescent lighting is treated under the incandescent chapter, whether service or exhibition. The outside lighting of the buildings, cornice lighting, and the border lighting around the lagoons, the lighting plants and quantity of lighting in each of the buildings, are important items of this chapter, and the varieties of decorative lighting all over the grounds as well as in the electrical building.

ILLUSTRATION FROM THE NEW BOOK, "ELECTRICITY, AT THE WORLD'S COLUMBIAN EXPOSITION." NIGHT SCENE LOOKING ACROSS COURT OF HONOR FROM THE ELECTRICITY BUILDING TO COLONNADE.

In the chapter on arc lighting, the service for lighting the grounds is treated, and that for lighting each of the buildings, the system of transmission in subways and conduits, the Corona lighting in the big manufacturers building, the great search lights, with figures showing the method and cost of their operation, the electric fountains, with an accurate description of their construction and operation, as well as a number of full page illustrations taken inside the caissons, also others giving the lighting effects with color values.

The power plant is minutely described with a full account of the methods by which the distinct plants were made to operate, when demanded, as one great system. The account of the intramural road is especially valuable as well as interesting. The figures showing economy and efficiency in comparison with figures on the Manhattan elevated, the Liverpool road, and the Alley "L" have never been published, and will go far toward convincing the public that electricity as applied to elevated roads is not only feasible but profitable as against any other motive power. An interesting chapter is that devoted to storage battery work including an account of the electric launches that gave so much pleasure to all during the fair.

It is to be regretted that Prof. Barrett could not have gone editorially deeper into his subjects with a view to sharp criticism, but the position the writer occupied at the Fair, would naturally limit him in this regard, and the few expressions of judgment will have greater weight because they are carefully considered, and more carefully formulated in print. In his preface the author suggests rather apologetically, that he has prepared the work because he believed the contents ought to be preserved in published form. In this he is certainly correct, especially as there is no present likelihood of there being any other World's Fair report.

Prof. Barrett's book is well gotten up; a very appropriate figure of liberty enlightening the world by electricity adorns the silk cloth cover; the dedication "To the Exhibitors in the Department of Electricity," is a pretty and deserved compliment to the electrical people. The book is printed on fine enameled paper, permitting the best effect of the illustrations, of which there are nearly two hundred, more than one hundred of which are full page. The night scenes are especially good, as are also the photographs of the fountains and the power plants. The only ornamentation allowed in the books is in the pretty and unique conceits for initial letters of the chapter beginnings. At the end of each chapter is a similar etched conceit, taking the Midway for the scene. Out of all the great quantity of World's Fair literature given to the public, it is refreshing to find one work got up for a purpose other than its sale to the average reader. Prof. Barrett makes the point that he has not tried to brighten the book with a view to its popularity, for the reason that he found that such a course would not only fail of its direct object, but would moreover spoil the value of the work for the electrical people.

In the preface the author says "The book will be read only by those who are interested in electricity, and by those it will be read for the information it contains."

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Graham, Va.—The Graham Bluefield Electric Light & Power Company will construct a 2,000-light plant, also a street railway.

San Francisco, Cal.—The Western Light & Power Company will add to its equipment a 1,500-light dynamo. A. Bowie is purchasing agent.

Norfolk, Va.—The Electric Company of Virginia will largely increase its power plant.

Leadville, Colo.—The Leadville Electric Light & Power Company will add a 1,000 light alternating machine. H. D. Riggles is purchasing agent.

Tallapoosa, Ga.—The Vernon Light & Power Company may add an alternating machine this fall. W. H. Brown is purchasing agent.

Washington, O.—The Washington Gas & Electric Company contemplate the addition of a 60 horse-power engine. J. Penn is purchasing agent.

Wahpeton, N. D.—The Northern Electric Light Company contemplates extending its lines. C. G. Nickells is purchasing agent.

Navasota, Tex.—E. L. Bridges desires quotations on a good second-hand 10x14 air compressor.

Valley Falls, Kan.—E. A. Maxwell desires quotations on 32 candle-power series incandescent lamps.

Big Rapids, Mich.—The Mecosta Electric Company will add another turbine. H. Boardman is purchasing agent.

Hoopeston, Ill.—The Hoopeston Canning Company will add a 35-light arc dynamo for street lighting.

Deckertown, N. J.—The Sussex Electric Light, Water & Power Company is about to change its power from steam to water. B. W. Decker is purchasing agent.

Columbus, O.—The Columbus Gas Company is installing a 2,600 light apparatus. Irvine Butterworth is purchasing agent.

Goliad, Tex.—The Goliad Water Power Company will erect an ice, light and water works plant this fall. It will be operated by water power obtained by building a dam across the San Antonio river. F. R. Starr, jr., Gonzales, Tex., can give further information.

Fremont, O.—The Fremont Street Railway Company contemplates a three-mile extension of its lines.

Graham, Va.—The Graham-Bluefield Electric Light & Power Company proposes to build an electric railway, to be three miles in length.

Galveston, Tex.—The Galveston City Railroad Company will equip, electrically, four additional miles of road.

Sioux Falls, S. D.—The South Dakota Rapid Transit Company contemplates extensive improvements and additions. F. H. Files is general manager.

Durango, Colo.—The Durango Railway & Realty Company may build its road this season. Henry J. Arnold is purchasing agent.

NEW INCORPORATIONS.

Chicago, Ill.—The Florida Engineering and Construction Co., capital $150,000, for the construction of railway and telegraph lines, electric lighting and power plants.

Eagle Grove, Iowa.—Eagle Grove Electric Co., to furnish electric light, heat and power; capital stock, $30,000.

Goliad, Tex.—Goliad Water Power Company, to furnish electric light, heat, water and ice; capitalized at $30,000.

Peoria, Ill.—Diamond Electric Company for the manufacture of electrical appliances, etc., with an authorized capital of $60,000.

Chicago, Ill.—The Chicago Cross Arm Company, with capital stock of $6,000 for the manufacture of electrical specialties, etc.

Leavenworth, Kan.—The Leavenworth Electric Railroad Company, $300,000.

Manchester, N. H.—Brodie Electric Company, for the manufacture of electrical apparatus, $25,000.

Newark, N. J.—Osborne Switch Company, for the manufacture of electrical machinery, $100,000.

Minneapolis, Minn.—The United Electric Corporation for the manufacture of electrical apparatus, operating street lighting, street railway and power plants, $10,000.

New York City.—Barriett Electric Motor & Dynamo Company to manufacture electrical motors, dynamos, etc., $20,000.

Buffalo, N. Y.—The Ellicott Electric Heating Company, $25,000.

Cleveland, Ohio.—The Cleveland and Elyria Railway Company to operate electric railways, etc., capital stock $100,000.

Chicago, Ill.—The Emmons Electric Company, for the manufacture of electrical appliances, on July 5, with capital stock $50,000.

Louisville, Ky.—The Fire & Police Telegraph Company to deal in electrical apparatus on July 3, $50,000.

Saratoga Springs, N. Y.—The Peoples' Gas and Electric Light Company, of Saratoga Springs, on July 3, $75,000.

Toledo, Ohio.—The Toledo Consolidated Electric Company to supply electric Light and power, $100,000.

Cleveland, Ohio.—The Nash-Eddy Company, for the manufacture of mechanical and electrical apparatus, $12,000.

Coraopolis, Pa.—The Coraopolis Electric Light Company, $25,000.

Philadelphia, Pa.—The Delaware Valley Electric Railway Company, $1,000,000.

Chicago, Ill.—The Murphy Power Company, for the manufacture of electricity for light, heat and power, on July 11, $3,000.

Shelbyville, Ind.—The Mutual Telephone Co., on July 3, $10,000.

Jersey City, N. J.—Citizens' Telephone Exchange Company, on July 9, with capital stock of $150,000.

Gouverneur, N. Y.—Oswegatchie Light & Power Company, on July 6, with capital stock of $60,000.

Elbridge, N. Y.—Elbridge Manufacturing Company, on July 9, with capital stock $10,000.

Yonkers, N. Y.—The North & South Electric railway, with a capital stock of $50,000, was incorporated on July 9.

Brooklyn, N. Y.—The Brooklyn Gas & Electric Company, for the manufacture of gas and Electricity, $10,000.

Mansfield, Ohio.—The Mansfield Telephone & Message Company was incorporated on July 7 with a capital stock of $30,000.

Defiance, Ohio.—Defiance Light and Company for supplying gas and electricity and the operation of electric street railways, July 9, $100,000.

Cincinnati, Ohio.—The Fitzimmons Telephone Company, $250,000.

San Francisco, Cal.—Los Angeles Edison Electric Co. to operate electrical machinery for supplying heat, light and power; $500,000; July 9.

Oelwein, Iowa.—Oelwein Telephone Company, to conduct a telephone exchange; capital, $5,000; July 12.

Pittsburgh, Pa.—Pittsburg, Frontenac & Suburban Electric Railway Co.; capital, $75,000; July 9.

Portland, Me.—Universal Electrical Messenger Call Company for the manufacture of electrical and mechanical appliances, etc., with a capital stock of $100,000.

St. Johnsonville, New York.—Inter-State Telephone Company, with a capital stock of $3,500; July 13.

Lockport, N. Y.—Lockport Gas & Electric Light Company to supply gas and electricity for light, heat and power; capital stock, $150,000; July 17.

Cincinnati, Ohio.—The Cincinnati Electric Service Company, with capital stock of $10,000; July 17.

Sandusky, Ohio.—The Sandusky Telephone Company, on July 18; $30,000.

Philadelphia, Pa.—The Clamond Telephone Company; $300,000; July 11.

Elizabethtown, Pa.—The Elizabethtown Electric Light Company on July 16, with a capital stock of $10,000.

Seattle, Wash.—Seattle Home Telephone Company on July 10, with a capital stock of $100,000.

Chicago, Ill.—Belding Electric Alarm Mail Box Co., capital stock $100,000; incorporators, Edward C. T. Belding, Thomas W. Saunders and C. Stuart Beattle. To manufacture Belding's electric alarm mail box, etc.

Chicago, Ill.—Chicago Harrison Telephone Company at Chicago; capital stock $4,000,000; incorporators, Thomas Whitney, M. A. Roe and G. R. H. Hughes.

Cleveland, Ohio.—The Standard Telegraph and Telephone Company; $50,000.

San Antonio, Texas.—National Union Telephone Company, July 23d with capital stock $50,000, PITTSBURG, PA.,—The work on the survey for an electric railway which will connect Pittsburg with Tarentum, Natrona, Springdale, Freeport, and numerous intervening towns up the Allegheny river was recently completed. The survey extends from Etna borough to Tarentum. The route beyond that point had been previously surveyed. The line will connect with the Pittsburg, Allegheny and Manchester road at Etna. This same company own charters covering a proposed line to Butler, via Etna and Glenshaw and it is said to be interested in other lines as well. The West Penn railroad now enjoys a monopoly of this and the passenger traffic. In order to avoid serious opposition of the West Penn the survey of the electric line has been so made that it will not be necessary to cross the West Penn tracks at any point.

NEW BOOKS.

Electrical Engineering Leaflets, by Prof. E. J. Houston and A. E. Kennelly, F.R.A.S., 1894, New York. The Electrical Engineer, 203 Broadway. Subscription, $3.00.

These leaflets have been prepared in three grades. The first grade is called the elementary, and is designed for beginners in the study of electricity. The intermediate grade is for the student or those who have not a technical training. The third or advanced grade is intended for those taking technical courses. The text is illustrated by diagrams and drawings.

How To Build Dynamo Electric Machinery. By Edward Trevert, Lynn, Mass, 1894. Bubier Publishing Co. 350 pages, with numerous cuts and working drawings. Price, postpaid, $2.50.

The interest taken by the students and amateurs in electrical machinery has created a considerable demand for books that give instructions for the construction of dynamos and motors. This volume has been prepared to meet the wants of those who desire a more complete work on this subject. Previous books and pamphlets giving the necessary data, with drawings for building small machines of this kind, have been eagerly read and in many cases the reading has been followed by the construction of the machines described. Some have made very interesting toys and others reliable and efficient machines. All have acquired a practical knowledge that would be more beneficial than from many times the same amount of time spent in reading. The volume opens with some historical notes concerning the discovery of the fundamental principles involved in dynamo electrical machines. The data necessary for the construction of a large number of machines are given. The drawings show the sizes and shape of the different parts, which are fully described in the text. A considerable space is devoted to commercial types of dynamos and motors and the appendix contains some practical directions for armature and field magnet windings.

American Street Railway Investments, an annual supplement to the Street Railway Journal. 1894. New York. The Street Railway Journal Publishing Co., 216 pages, 24 maps, cloth. Price, $5.00.

This work, which covers one of the most prominent and important industries, is the most complete of its kind. The need of such a book of reference has long been apparent, but the difficulty of securing the information has been unsurmountable to those who have previously attempted it. It is published for the use of bankers, brokers, capitalists, investors and street railway companies with special reference to whose needs the information has been gathered. The street railways of our cities are looked upon as one of the best investments which have been open to capital. The rapid growth of the population of the cities and neighboring suburbs is steadily increasing the value of these investments. So thoroughly has this field been covered that there is scarcely a town or city of over 10,000 inhabitants but that has its street railway. At the present time the industry may be considered as upon a substantial basis well organized and under experienced managers. The introduction during the past few years of the cable and electric systems of traction has greatly aided in the advancement of this industry. In compiling this work, which is more than a directory, information has been gathered respecting not only the roads themselves, but respecting the cities or towns in which they are operated. The importance of this is apparent when we consider how much the stability of the road depends upon the character of the city and its industries. The numerous maps of the larger cities showing the railway lines are also valuable to those interested in the study of railways, either as investments or regarding their management and operation.

Alternating Current Wiring and Distribution. By Wm. Le Roy Emmett, E.E. New York, 1894. The Electrical Engineer, 76 pages. Price, postpaid, $1.

The subjects here treated are of special interest and importance just at this time when the alternating current systems of lighting and power transmission occupy more prominent positions than ever. Recent improvements in the apparatus and systems of distribution, and new enterprises, in which are involved many new problems, have awakened new interest in this branch of the electrical industry. While in general the laws and principles that govern direct current wiring are the same as those that govern the distribution of alternating currents, there are other factors and modifications of these rules to be made to secure the best results. In this volume there are pointed out the laws which govern the distribution of alternating currents. They are treated in such a manner as to make them of the most interest to the practical man. The time is already here when a knowledge of alternating current apparatus and methods of distribution is absolutely necessary to the station manager and superintendent. Recent experiments have added a considerable to the knowledge of the subject, and the more recent publications contain, therefore, the more complete information. The author covers the subject carefully and treats it in such a way that it is easily understood. The various elements that resist the passage of the current are discussed, and the loss in the transmission and distribution is fully stated. The effects of transformers and motors in circuit are taken up. The use of step-up and step-down transformers in long distance transmissions is discussed in two chapters. The multiphase systems receive attention in Chapters 19 to 22. That part of the volume given to conductors, ducts, concentric cables, etc., for the transmission and distribution of alternating currents will undoubtedly be found as interesting as any portion. This information, which is not so generally understood, is plainly stated. On the closing pages, by means of diagrams, many of the terms and relations are illustrated. The work is in a compact form and is sufficiently complete for a perfect understanding of the subject. It has been prepared with special reference to the practical man and to him the book is commended.

Legal Note.

The decision of Judge Dallas, of the United States Circuit Court in Philadelphia, in the suit which was brought against the Citizen's company of Lancaster, Pa., users of Buckeye lamps by the Edison Electric Light Company, settles for the present at least one point at issue. Judge Dallas decided that as an injunction had already been refused against the manufacturer the customer cannot be enjoined. The Buckeye company has successfully defended a number of suits brought by the owners of the Edison patents.

The American Extravaganza Company, under the direction of Manager Henderson in the new spectacle "Aladdin Jr." has amused this season the play-going public as it has in previous years with other spectacles. The magnificent scenery and the abundant use of the electric light which under the rare skill of the electrician of the house is made to produce some most brilliant scenics and dazzling effects are some of the attractive features. These features are being constantly changed and something entirely new is promised in the third edition of "Aladdin, Jr." which will shortly appear. The electric light is now used in every modern theater and in the Chicago Opera House, where the above play is to be seen the electrical equipment is most complete, affording the production of lighting effects which are wonderful.

The Chicago Tribune has the following to say regarding Chas. A. Schieren, which shows that belt making is not the only thing he had made a record in: "Mayor Schieren, the reform mayor of Brooklyn, N. Y., announces publicly that he is not a candidate for governor. He says: "At the end of two years I shall retire from the office of mayor, and I shall not be a candidate for another term. I accepted the office at a sacrifice. The man who successfully administers the affairs of so great a city as Brooklyn occupies as exalted a position as the governorship." This is from the man who has smashed the corrupt Brooklyn machine, swept the departments clean of all lazy political loafers, given the people 90-cent gas and 3-cent cable fares, and saved the city $1,000,000. Mayor Schieren needs no further popular honors, but it is to be regretted that the state of New York cannot have a governor as clean, manly, honest, and business-like as Brooklyn's model mayor."

FINANCIAL.

The volume of business for the past month was greatly lessened by the short but distressing railroad strikes. The increased business of the latter half of the month, however, helped to make up for the loss during the first of the month. Every industry still feels the restraint of the unsettled tariff question. The markets have been quiet and prices have changed but little. It being a season of vacations and oppressive weather, there has been little trading and few quotations. The strength of the market would indicate that prices would be better for all classes of securities. Money is plentiful and rates low.

In the electrical industries business is more active. A number of important contracts were let last month, but prices have been extremely low. The improvements soon to be made in the West and North Chicago Street Railways, will require a large amount of electrical material. The work, it is expected, will run through several years, as it is the opinion of the managers that it will be easier to distribute the expense over several years, the lines can be more economically built, and traffic will be less impeded during the period of reconstruction. Manufacturers have secured many orders from the smaller towns and cities of this and neighboring states for apparatus.

One of the pushing branches of the electrical field is that occupied by the telephone. Some of the more recently organized companies have been meeting with success as shown by the number of exchanges put in. The cities especially of the Mississippi valley have been quick to adopt this modern device, and the number of exchanges has grown rapidly. The larger exchanges have been most profitable investments as shown by the history of the Bell company, which will soon increase its capital stock to $50,000,000, and small exchanges should, with the experience of the present time, yield a fair return for the investment.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING July 52.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	195
" " "	Bds. 1893.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co... ...	Com.	14,000,000	100	....	....	89
Commercial Cable Co	Com.	7,716,000	100	....	....	125
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	F. Q.	115
" " " ...	C.Bds. 1898.	71,000	100	6	M. & S.	.....
" " "	C.Bds. 1901.	586,500	100	6	M. & N.	.....
" " Brooklyn..	Com.	2,500,000	100	....	Q. F.	85
" " " ..	1st. 1940.	500,000	100	5	A. & O.	100
" " " ..	Regis.	....	100	5	A. & O.	.....
" " Chicago...	Com.	3,000,000	....	8	Q. F.	135
" " "		2,500,000	....	....	....	.....
" " New York.	Com.	7,938,000	100	....	Q. F.	100
" " "	1st 1910.	2,562,000	100	5	M. & S.	107
" " Phila......	Com.	1,473,000	100	....	....	128½
" " "		... .	....	5	....	.....
Fort Wayne Elec. Co...... ...	Com.	4,000,000	25	....	....	.....
General Electric Company.	Com.	30,457,000	100	....	......	36½
" "	Prf'd.	4,251,900	100	....	....	70
" "	Deb. 1922.	10,000,000	100	5	J.-D.	86
Gold & Stock Tel. Co............	Com.	5,000,000	100	....	Q. J.	... .
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	90
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	...	....	.....
Thomson-Houston Elec. Co . .	Series D.	120,000	10	....	....	5⅜
Thom'n-Houst'n Intern.Elec.Co.	Com.	600,000	100	....	....	.....
" " " "	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co....	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q. J.	83
" "	Var. Issues	13,088,000	10	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass' ing.	5,333,940	50	....	....	36½
" " "	1st Pf.Cu n.	3,755,700	50	7	....	51
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R..............	Com.	6,000,000	10	....	Q.-J.	170
" "	1st Bds. 1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	....	Oct. 1.	......
" " " ..	1st Bds. 1909	300,000	100	5	J. & J.	.....
" " " ..	Certf. 1894.	300,000	100	6	J. & J.	.....
BUFFALO—						
Buffalo St. Railway..............	Com.	5,370,500	100	5	....	......
" "	Bds. 1931.	5,000,000	100	....	F. & A.	......
BOSTON—						
West End St. Railway..........	Com.	9,085,000	50	..	J. & J.	47
" "	Prf'd.	6,400,000	50	5	J. & J.	77
" "	Bds. 1902.	3,000,000	100	....	M. & N.	100½
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	......
" "	Prf'd.	1,000,000	100	5	A. & O.	......
" "	1st Bds. 1930	6,000,000	100	....	J. & J.	......
NEWARK, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	....	....	27⅜
" "	Bds. 1930.	6,000,000	100	5	J. & J.	84½
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	155
" "	Bds.	2,000,000	100	....	....	......
PITTSBURGH—						
Duquesne Traction Co....... ...	Com.	3,000,000	50	...	....	26
" "	Bds. 1930.	1,500,000	100	5	J. & J.	103
Fed. St. & Pleas. Val. R. R.......	Com.	1,400,000	50	....	J. & J.	20
" " " " "	Bds. 1919.	1,250,000	100	5	J. & J.	102
Pittsb'gh, Aleg. & Man. R. R.....	Com.	3,000,000	50	....		37
" " "	Bds. 1931.	1,500,000	100	5	J. & J.	103¾
Pittsburgh & Birming. R. R.....	Com.	3,000,000	25	....	....	12½
" " "	Bds. 1929.	1,500,000	100	5	M. & N.	95
ROCHESTER—						
Rochester Railway Company....	Com.	5,000,000	100	...	....	67
" " "	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway.............	Com.	2,500,000	100	....	Q. J.	91
" "	Bds. 1910.	1,500,000	100	5	J. & J.	103
St. Louis & Suburban............	Com.	2,500,000	400	....	....	12
" "	Bds. 1921.	1,400,000	100	6	F. & A.	185
Union Depot Railway............	Com.	1,200,000	100	....	....	150
" " "	Bds. 1910.	1,000,000	100	6	A. & O.	102½

TRADE PUBLICATIONS.

The New Science Review is the name of a new quarterly magazine that made its first appearance with July. It is devoted, as its name indicates, to science and new discoveries. It is not intended to supersede the older and more conservative periodicals, but to supplement them. It is published for the public at large and not for any class of specialists. The quarterly method of publication was selected by the publishers as allowing sufficient time for the exploitation of every new theory, invention or discovery. The volume just out contains 128 pages of selected and well written articles on such subjects as suit the public taste. Among the articles of interest to those connected with electrical pursuits is "Nikola Tesla and His Works" by Lieut. F. Jarvis Patten. The subjects of the articles are varied and all possess great interest to the popular reader. The contributors are familiar to most readers through previous contributions to the magazins and technical papers.

A pamphlet issued by the Westinghouse Electric & Mfg. Co. treats of the stopper lamp and its manufacture. A number of cuts are distributed through the pages showing the details of the lamp, the process of manufacture and in connection with a short article on the stopper lamp at the World's Fair, appears a very good reproduction of the sign which attracted so much attention on the south wall of electricity building. The stopper lamp , it says, saved the World's Columbian Exposition $1,000,000. The stopper lamp, as is well known, was used by the exposition for its incandescent lighting. The company has continued the experiments commenced before the stopper lamp was placed on the market by this company and as improvements have been discovered they have been incorporated in the stopper lamp. These improvements are described as they affect the quality of the lamp, increasing its efficiency or durability. The lamp is placed before the trade as being unexcelled and at a price not met by the all glass lamp.

Among the new catalogues received is one from the Royal Electric Company of Peoria, Ill., manufacturers of dynamos, motors and electrical supplies. While the catalogue is not large it presents the products of the company's factories in a very effective style. Special attention is called to the design and mechanical construction of the Royal alternating current dynamo, which has no wires, no windings or insulation on the revolving parts. The revolving portion of the machine is built up of laminated iron and contains nothing that will be injured in use. The various important details of these machines are very clearly pointed out and the illustrations show the simplicity and general features of the design. Tables giving the dimensions of the different parts, speed, capacity, weight and floor space occupied are distributed through the pamphlet. The exciter used with these machines is also of simple but efficient construction, mounted on a substantial base containing suitable attachments for regulating the tension of the belt. It is manufactured in sizes to meet the requirements of the alternators of different capacity. The necessary apparatus for the operation of a complete alternate system including transformers, station instruments, etc., are described and listed. Direct current dynamos and motors are also included in the manufactures of this company. The cuts show these machines to be well proportioned, of neat appearance and evidently durable and efficient. They resemble greatly many of the standard types of direct current machinery. A closer inspection, however, shows a great difference in the details of construction. The catalogue concludes with numerous testimonials of users of the Royal machines which indicate a growing popularity.

The Card Electric Company of Mansfield, O., recently issued one of the finest catalogues so far produced. It relates entirely to the single motor equipment for street railways manufactured by this company. The pages are handsomely designed and well printed. The cuts and illustrations are skillfully made and the catalogue speaks well for the enterprise of the company. The pages are printed in two colors, one of which is carefully worked into the initial letter that adorns each page. The paper used is of an excellent quality of book paper. The text is well written, and although not exhaustive, sets forth clearly the thoughts of the author. The advantages of the single motor equipment for ordinary roads are well stated and in the description of the equipment the main features are boldly presented. Respecting the use of double motor equipments, he says: "It seems to be the settled opinion of many, no matter what the conditions of track or traffic, whether over smooth roads or rough, up grades or down, using small cars or large, that two motors on every car, with their complicated controllers and still more complicated systems of wiring, is a necessary and indispensable part of the service. From this opinion we beg to differ and we do so primarily for the reason that it does not appear to us to be good business; we think that unless some ob tacle of a mechanical or electrical nature prevents, the apparatus for propelling street cars should have in some degree a propoitional relation, both in character and price, to the work demanded of it." The different classes of work are then taken up, showing the needs of each. The single motor equipment of the Card Electric Co. is described in detail. The special features of each part are given prominence by the lines at the corners of the page that contains the cut and which are printed in colored ink. To users of street railway apparatus this catalogue should possess a considerable interest.

An illustrated general catalogue, or what might better be called an encyclopedia of electrical supplies, has just been published by the Knapp Electrical Works, Chicago. The volume is a large one, containing some 500 well-filled pages. It is bound in both cloth and embossed flexible covers. The printing has been well done on book paper. The contents show most careful work and give evidence of perseverance as well as skill, on the part of the compilers. It will be found a most valuble addition to the commercial library of everyone connected with or interested in the electrical industries. A most complete reference book, it may truthfully be called an encyclopedia of electrical supplies. The trade catalogue is the sample trunk of the supply drummer. It is the ever present representative of the supply house. It facilitates the transaction of business and places before the buyer the goods on the market. The arrangement of the catalogue is excellent. The leading part of the volume is given to electrical conductors, which form a most important part of every electrical installation. Under this head an extensive line of cables is listed, covering those used for the telephone, telegraph and the transmission of electricity for light or power. Aerial, underground and submarine cables are among the important goods in this section which covers every kind of electrical conductor, whether for a magnet spool or for a telegraph line. Incandescent lamps and everything pertaining to incandescent lighting, follow. The list of goods illustrated in this section is most extensive and elaborate. It shows that standard specialties and supplies are handled, together with many designed by the conpany. Arc lighting supplies and line material cover everything from a search light to a stage lamp and from a lag screw to a telephone pole. The company carry tools of every kind used in electrical work. Fixtures in a great variety of styles and designs are illustrated, together with a most elaborate line of fixture glassware. Another important department which is well represented is that of annunciators and house goods. The company is a large manufacturer of these goods in all sizes and designs. Telegraph instruments, as well as electrical instruments of all kinds, are illustrated. It would be a task to mention all the goods which make up the contents of the catalogue. A personal inspection will, however, convince one of its excellence and completeness. For the benefit of construction men a large number of valuable wiring tables are given and also a complete copy of the rules and regulations of the Chicago Fire Department for the installation of wiring and apparatus for electric light and power. The Knapp Electrical Works should be congratulated upon the excellence of this catalogue.

A large and handsome catalogue has been received from the Allgemeine Elektricitats-Gesellschaft of Berlin. It is undoubtedly one of the finest and most complete catalogues issued by manufacturers of electrical apparatus. It contains a large amount of useful information which shows most careful work in compiling. To exporters the maps showing the railway and steamship lines of the world will be of interest as will also the tables giving freight rates between important commercial cities. The first 40 pages are devoted to general information with regard to electric installations. Tables give approximately the degree of illumination required per foot of floor space in interior and exterior lighting for different purposes and by different kinds of light. The information on this subject will be found most valuable in making estimates for installations. Numerous cuts appear showing the distribution of lights in various buildings. Isolated lighting plants, their design, size, etc., are considered. The use of accumulators, steam, gas engines, etc., with the space required and dimensions of the different portions of the plant are some of the features described. Under "Directions for preparing Approximate Estimates" the approximate cost of the various apparatus used in electric lighting plants and also of the completed plant, is given. Operating expenses are also estimated and the information given for preparing a detailed scheme and estimate is most complete. Comparative tables of English and German wire gauges, together with other tables of a commercial value, completes the introductory portion of the book. Part A is devoted to dynamos, which are exhaustively treated. Part B treats of switchboards and instruments, and part C conductors and the distribution of current. Switches and circuit connectors are grouped in part E; insulation and insulating material in part F; arc lamps and accessories in part G; glow lamp, fittings and electroliers in part H and J, and motors as used for driving various machines complete the book with part K. The apparatus manufactured by this company is very clearly presented in this volume. Although many of the designs are quite unlike those of American manufacture, yet the majority of them exhibit the same general proportions. It is in the smaller apparatus and appliances that the greatest difference of design and construction is noticed. These machines were displayed in the excellent exhibit of this company made at the World's Fair, and to many this apparatus is, therefore, familiar. The catalogue is gotten up in an excellent manner. The pages are ruled in color, which, especially in the tables, greatly improves the appearance of the page. The book is substantially bound in heavy, artistically designed covers. It is certainly a credit to any company and should increase the trade of this company, which already reaches the most distant parts of the world.

PERSONAL.

Mr. C. A. Brown, secretary of the Central Electric Company, is taking a vacation of a few weeks in the East.

Mr. Frederick Kemp, chief accountant of the Michigan Telephone Company, Detroit, was in Chicago for a few days last month.

Mr. G. A. McKinlock, president and treasurer of the Central Electric Company, is just recovering from a severely sprained foot, which has necessitated his walking with a cane for several days.

Mr. W. W. Low, president of the Electric Appliance Company, has just returned from a trip throughout the Northwest. Mr. Low, while away, attended the convention of the Northwestern Electrical Association.

Mr. Robert L. McElroy, succeeds his brother, James E. McElroy, lately deceased, as treasurer of the Harrison International Telephone Construction Company. Mr. Robert L. McElroy is also a member of the firm of James E. McElroy & Co.

Mr. Thos. I. Stacey, secretary and treasurer of the Electric Appliance Company, starts August 1 on an extended trip throughout the East, visiting all the principal cities. Mr. Stacey will combine business with pleasure and will be absent for the entire month.

Mr. George K. Hooper has just opened an office at 1422 Monadnock block as western agent of the Abendroth & Root Mfg. Co. Mr. Hooper was formerly located at Rochester, N. Y., and brings with him an extended experience. He will push the business of his company in the west, in which his many friends wish him success.

BUSINESS NOTES.

The National Electric Company, of Eau Claire, Wis., has furnished the electrical apparatus for a number of recent plants, among which are the station at Caldwell, Ohio, the Leland Hotel, Chicago, and the Municipal plant at Sandwich, Ill. The contracts recently made show a still larger number for the future.

The Central Electric Company, Chicago, in all its departments finds business very satisfactory considering the general trade conditions of the country. The fan motor business of the company has been especially lively during the heated season. Collections, however, the company reports are somewhat slow.

Brownell & Co., Dayton, Ohio, manufacturers of boilers and engines, have bought the exclusive right to manufacture under the patents of C. M. Giddings. The company has also purchased from the Sioux City Engine Works, drawings, patterns, finished and unfinished work. Mr. Giddings has been placed in charge as superintendent of the engineering department.

Cushing & Morse, Chicago, general western agents for Kerite wires and cables, report that their semi-annual statement for the first six months of the present year show a large increase of business over the corresponding period of 1893. In view of the general great business depression this showing is very satisfactory, and reflects much credit on the firm and their specialty.

Mr. George Cutter, the Rookery, Chicago, has taken the agency for the states of Michigan, Indiana, Wisconsin and Illinois, for the Interior Telephone Company. In this field Mr. Cutter's long experience will aid greatly in successfully conducting this agency. The sale of Chicago Electric wire has been very encouraging and for the many other specialties with which the trade is familiar the demand is increasing.

The Emerson Electric Manufacturing Co., St. Louis, Mo., has placed on the market a number of well designed switches which are made in sizes and patterns to suit the requirements of any station. The metal parts are well constructed and finely polished. They are mounted on slate bases. The company reports a large demand for this grade of switches and large orders usually include a number of sizes. The sale of electric fans has been large, and recent improvements have added largely to their efficiency.

The Berlin Iron Bridge Company, East Berlin, Conn., recently received the contract for the station for the new electric and power plant of the Bradford (Pa.) Electric Light & Power Co. It is said that it will be, when completed, one of the finest stations in the country. The building is 65 feet wide and 160 feet long. The walls are of brick and the roof of iron covered with the Berlin company's patent anti-condensing, corrugated iron roof covering. The building will be absolutely fire-proof, no wood being used in its construction.

The W. S. Edwards Manufacturing Company reports that it is running full time and with its full force. This company is to be congratulated that it has had a good number of orders to fill during the depression, and the outlook with it for a large fall trade is very bright. The company makes a specialty of electric and combination fixtures, and in order to supply the wants of the trade, it is now preparing a new catalogue devoted entirely to this branch of the business. This catalogue when completed, the company claims, will be the finest of the kind ever issued by anyone.

Mason's Electrical Exchange, 943 Fulton street, Brooklyn, N. Y., has on the market an extensive line of batteries. Special attention has been given to continuous current batteries, and of this style, a variety of batteries have been produced. "Mason's perfected battery" has been designed for all purposes where a battery is in continuous use. For phonograph work, driving fans or for small isolated plants, the perfected battery is especially adapted. The expense of keeping up the battery is very slight, the jars, porous cup and binding posts being durably constructed. The attempt to always please customers, and of shipping goods promptly, has given this house a favorable position in this field.

The Harrison International Telephone Construction Company has moved its general offices to the Chamber of Commerce Bldg., Chicago. The western business of this company has grown so fast that this move is made in order to be nearer the center of the field covered by the trade. The demand for telephone service is everywhere increasing when it is known that the same can be secured at a reasonable figure. The central states afford a large field for telephone exchanges, and both in the north and south numerous exchanges are being put in. The company has sent out a large amount of literature on the subject of telephones that has been eagerly read. To persons interested a card sent to the address of the company will bring any information desired.

The Metropolitan Electric Company, 186-188 Fifth Ave., Chicago, reports continued improvement in the demand for electrical supplies. N. I. R. wire and I. X. L. wire are considered standard goods and in filling orders for these goods a force of men is constantly employed. Mac tape has demonstrated its high qualities in construction work and the number of orders for it are constantly increasing. The India rubber in its composition makes its insulation unquestioned. The Lowell wrench is a favorite with construction men and the tool chest of line men is incomplete without one. The company is constantly adding new specialties to its already extensive line. The P. & B. insulating products are known to every station man. The Metropolitan company are western agents and have every facility for supplying orders for these paints and compounds.

The Siemens & Halske Electric Company of America has now offices in sixteen of the largest cities of the United States. Among the offices opened more recently are the Detroit office at 47 State St., and the Minneapolis office at 939 Lumber Exchange. The company is one of the largest competitors in the American market. Its goods include almost everything electrical, and the reputation of the company is so well-known that they require no introduction to users. The shops of the company are being improved, and present a scene of activity, notwithstanding the unfavorable conditions of trade. Many large and important plants have been installed by this company during the past year which are making records for economy and efficiency. The contracts recently secured call for a large number of special machines. The facilities of the company for the manufacture of large as well as small generators, permits machines of any size to be furnished.

Fisher & Porter, 1025 Monadnock Block, report that they have just installed two 80 horse-power "M. A. Green" engines in the Leland Hotel, where they are running two National dynamos for incandescent lighting. They have sold one 150 horse-power "M. A. Green" engine to the Freeport Electric Co., of Freeport, Ill., for electric street railway work, and one 300 horse-power "Improved Greene" engine to the Hammond, Whiting and East Chicago Electric R R. Co., at East Chicago, Ind. Messrs. Fisher & Porter are western representatives of the Altoona Manufacturing Co., building the "M. A. Green" engine, and of Providence Steam Engine Co., building the "Improved Greene" engine, and report that the works of both companies are running full time, and that they see prospects ahead for a good business.

Lee & Collins, Medina Bldg., Chicago, is the name of a new firm, which, as manufacturers' agents, will handle standard electrical goods. Nothing but first-class goods will be carried and a large stock will enable prompt delivery of all orders. Batteries and battery material will form one of the important lines. As agents for the Hayden-Booker Mfg. Company, the well known batteries will be carried. Battery motors, annunciators, porcelains, compounds and insulating paint are among the specialties. The gentlemen comprising the firm are well known to the trade. Mr. C. E. Lee has for several years represented a number of prominent manufacturing companies. Mr. L. W. Collins has an extended acquaintance among the electrical fraternity, having been for a number of years connected with several of the prominent electrical journals. Thus with a large number of friends and acquaintances, and experience in this field, the business should meet with success.

Edward F. Austin, contracting engineer and manufacturers' agent, Pittsburg, Pa., reports a growing demand for the M. A. Green engines. Since he took the agency of these engines their merit has been brought to the attention of steam users, who now are beginning to appreciate the worth of the engine for power plants. Among recent sales are the following: One 80 horse-power to the New Castle Car Mfg. Co., of New Castle, Pa.; one 150 and one 180 horse-power engine to Jones & Laughlin of Pittsburg, to run in connection with the electric cranes which were recently erected in their mills; two 60 horse-power engines to the McIntosh-Verner buildings of Pittsburg; one 12x14 engine to the Lorch-Eble Machine Co. of Pittsburg, and one 150 horse-power engine to the Watson Mining & Mfg. Co. of Monongahela City, Pa. Mr. Austin also furnished a 50 horse-power Green engine for the Christ Church isolated plant of 500 lights capacity which is the first church plant installed in that section.

The Electric Appliance Company, 242 Madison St., Chicago, has been sending out to the trade a catalogue of porcelain goods, a large stock of which it carries. The insurance regulations, which call for better insulation in electrical installations, have greatly increased the demand for these goods. The company has established a department, in connection with the incandescent lamp department, for coloring incandescent lamps. The demand for colored lamps for decorating purposes has been sufficient to warrant this step and persons desiring colored lamps can now obtain them. A number of street railways have been furnished with Packard Mogul lamps to burn four or five in series. This kind of lighting has been found very satisfactory and the cost of installation much lower than for arc lamps. For alternating current circuits the Meston fan motor is furnished and for direct current the Acme fan motor. These two motors have been handled in large numbers by the Appliance company this season.

The General Electric Company recently received a communication containing the following extract from Mr. Clark, general manager of the Coeur d' Alene Silver & Lead Mining Co., in which mine an electric plant was installed: "In respect to the relative merits of steam and electricity at the Poorman mine, I will say that the amount saved in fuel is about $100 a day. This, of course, is due to the fact that we generate electricity by water power. How electricity would compare with steam in the matter of cost if the former were generated by steam power, I am not prepared to say, but am of the opinion that where steam has to be transmitted a long distance underground, particularly where it is wet, that electricity generated with steam and transmitted to the pumps or other machinery, will be found to be the most economical, the percentage of loss in transmission being so much less; in addition to this, the cumbersome steam pipes, with their destructive effect on shaft timber, is avoided. We have five machines in use: two 175 K.W. at the generating station, one and one-half miles distant from our works, where they are operated with Pelton wheels under 800 feet head; one 175 K.W. to drive our concentrator; one 150 K.W. machine for the pump, raising 500 gallons of water per minute 500 feet; and one 175 K.W. for the compressor. This system has been almost two years in operation."

ELECTRICAL INDUSTRIES.

Vol. V. CHICAGO. September, 1894. NEW YORK. No. 9.

Petersburg Electric Lighting Plant.

One of the best evidences of the enterprise of the towns and cities of the middle and western states is the numerous electric lighting plants by which they are lighted. The electric lights attract the attention of travelers and give the towns a live and progressive appearance. In a trip through any section of the country the different interest manifested by travelers in towns well lighted and those that are not, is always noticeable. Illinois possesses many advantages for the production of electricity and the number of plants, which is already large, is constantly increasing. An abundance of coal at a very low cost enables electricity to be delivered to customers either for power or lighting at a small price per annum.

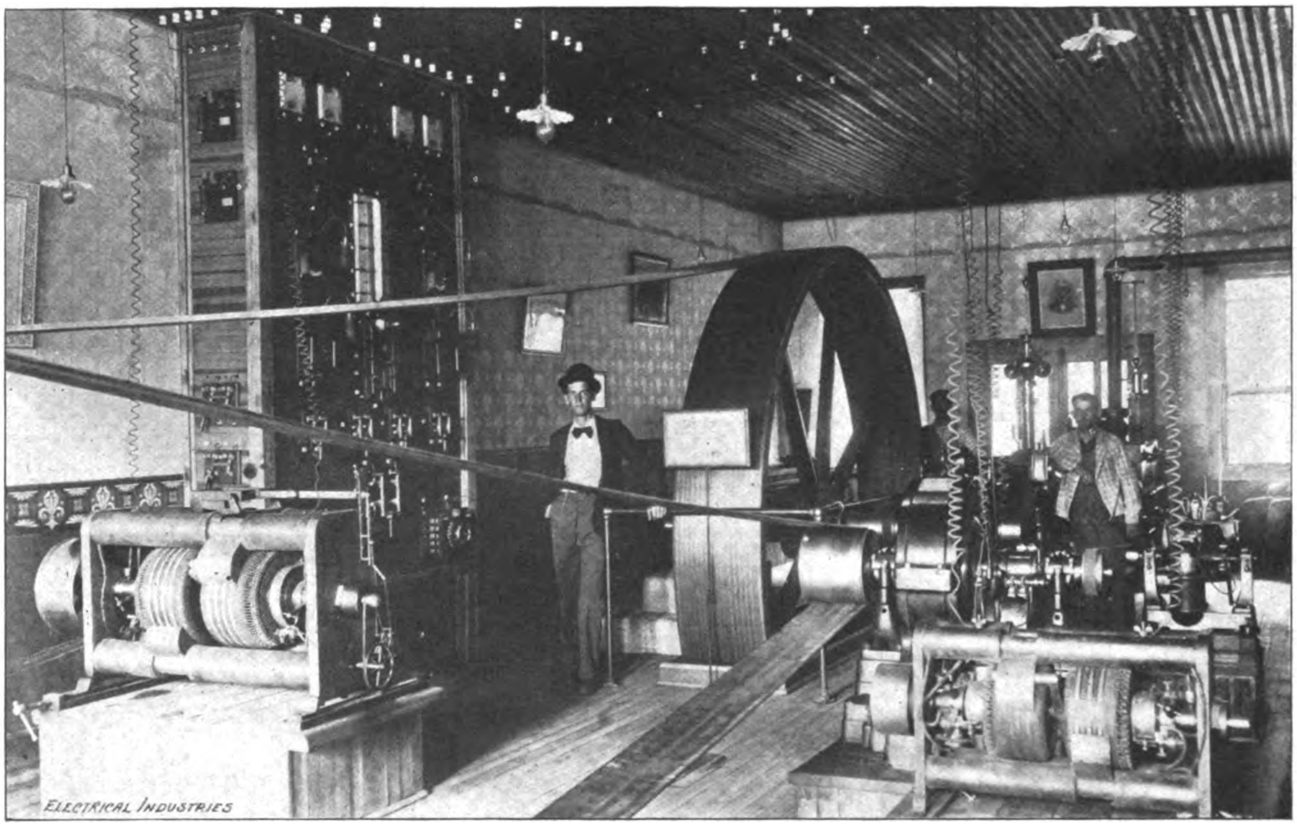


FIG. 1.—PETERSBURG ELECTRIC LIGHTING PLANT.

In the accompanying engravings are shown some views of the Petersburg, Ill., electric lighting plant, owned by J. B. Abbott & Sons. Although having but about 3,500 inhabitants, Petersburg is well lighted with arc lamps, and for stores and residences is supplied with alternating current incandescent lights. The business was started in 1888 by Mr. Charles D. Wright, who built the first station and installed a 25 four-ampere arc dynamo of the Ball type and a 40 horse-power Ideal engine. This station was located about a mile from the city at the works of the South Valley Coal Company, from whose plant steam was secured.

About a year later a rough frame building was secured in the city, and the plant was moved nearer the center of the district to be lighted. It afterwards passed into the hands of the Electric Light & Power Company, who erected a new two-story brick building 50 by 70 feet. A new 50 horse-power boiler was installed and also a 70-light Ball arc dynamo. In 1892 it passed to its present owners who added an engine room 22 by 70 feet. The plant is under the management of Mr. R. H. Abbott, who has installed a new equipment. A Bates-Corliss engine of 150 horse-power, a 64-light arc and a 50-light arc, a 1,000-light T.-H. alternator, a new 50 horse-power boiler and a 100 horse-power feed water heater were put in. A large switchboard, 8 by 14 feet, was erected. A Weston ammeter, T.-H. volt and ampere meters for the incandescent lighting circuits, lightning arresters and other apparatus for the regulation and control of the dynamos, are mounted on the board.

The switch board is constructed of seasoned pine and wherever wires pass through the board it is bushed with porcelain bushings. The wires pass from the board to a tower on the center of the building, from which they radiate in the different directions. On the first floor of the station is located the engine and dynamo room and also the boiler room. The second floor is used for store-room, repair shop, etc. The engine is belted by a 21-inch belt to a countershaft, from which the different dynamos are belted. These belts were manufactured by E. B. Preston & Co., of Chicago, and have given every satisfaction. In fact, they have been noticeable on account of their perfect service.

The Bates engine has more than met the expectation of the engineers and since it has been in use, the coal consumed, it is said, has been reduced nearly 25 per cent. It has been servicable and has not caused a shut-down since it was started.

The incandescent lighting district is divided into four sections and each section is fed by one circuit from the station. A considerable attention has been given to residence lighting and a fair load is secured from these customers. The Thomson recording meter is used for each customer and meter rates are charged to all. This has proved very satisfactory to both the owners and the customers. The streets are lighted by arc lamps for which the city pays a yearly rate of $48 per light. The lamps are operated on a moonlight schedule until midnight. This is certainly a very low price and can only be accounted for by the abundance of cheap fuel, the plant being located in the midst of a mining district. Fuel for this station costs but 25 cents per ton.

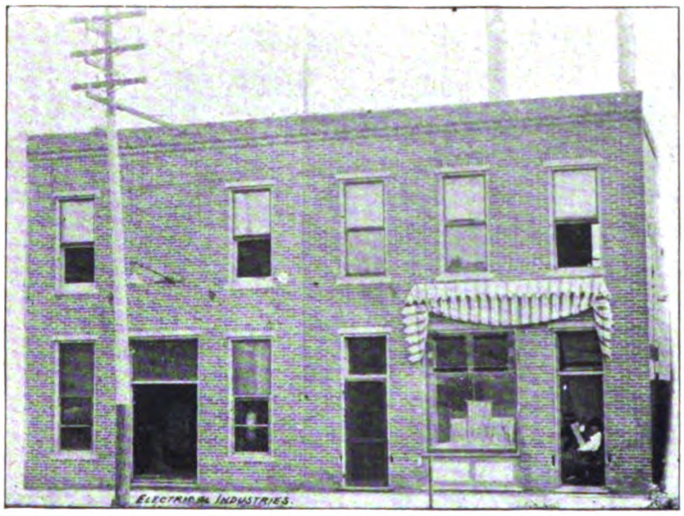


FIG. 2.—PETERSBURG ELECTRIC LIGHTING PLANT.

The city at one time investigated the subject of building a municipal plant, but after an investigation of the matter it was concluded that the contract price was as low, if not lower, than the city could operate a plant itself. In arriving at this conclusion the officials did not have to look very closely into the matter, and the city may congratulate itself upon being able to secure such favorable terms.

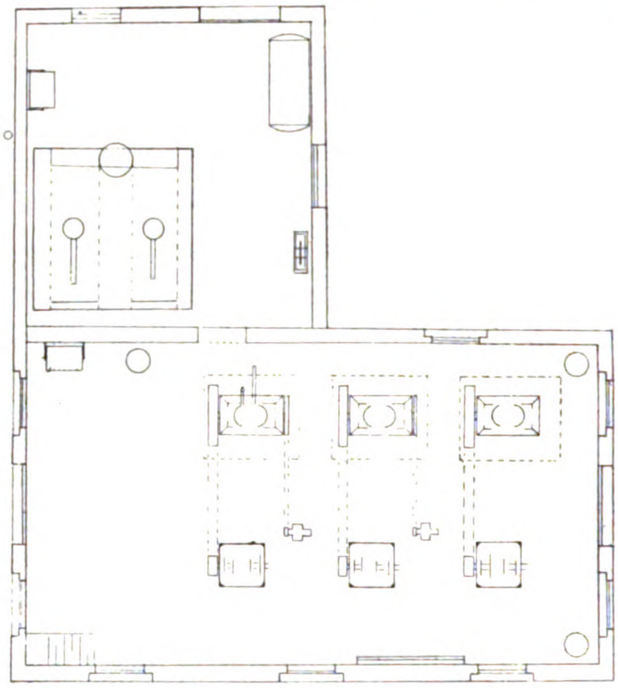
The cheap fuel, good water and other advantages have attracted a number of manufacturing companies to Petersburg, whose enterprising citizens are ready for anything that will benefit the city. Its railroad facilities are excellent, having the advantages of both the C. & A. and the C., P. & St. L. railroads.

The Apollo (Pa.) Electric Lighting Station.

The station at Apollo, Pa., is remarkable for several things. I might mention the excellence of the equipment, the neat finish of every piece of machinery and the extreme cleanliness of every part of the station. The building is a substantial structure, built of brick. The interior walls are plastered, wainscoted and painted. The walls have been further decorated by many pictures which seem to interest the average visitor as well as the engineer. The station is a two-story building, the machinery occupying the lower floor while the second story is used as a repair shop and store room. The station is in charge of Geo. W. Kendrick.

The boiler room which is separated from the engine room contains two 60 horse-power tubular boilers. The fuel used is natural gas which makes no dust or dirt about the station. A Lowell gas regulator is used which effects a very close regulation of the fires and consequently a steady steam pressure in the boilers. This regulator has been found a great advantage in the operation of this plant, saving fuel and giving an even steam pressure of 105 pounds.

In the engine and dynamo room there are three 60-horse power Westinghouse engines to which are belted direct two 1,250 light Westinghouse alternators and one Westinghouse arc dynamo. The exciters are also belted to the engine. These machines are each of the standard type of Westinghouse machines. Westinghouse instruments are used on the switchboard, which is of a neat design, containing modern instruments for the operation of the plant. The parts of the machines and engines which are brass or copper are kept carefully polished. The valves and checks are bronzed and parts that are not kept bright are painted. Iron receptacles are placed in convenient parts of the station for waste.



THE APOLLO (PA.) ELECTRIC LIGHTING STATION.

The station is well lighted, having two arc lights and 14 32-candle-power incandescents. The plant is abundantly supplied with pumps, heaters, etc. The feed water heater furnishes water to the boilers at a temperature of 180 degrees. The protection against fire is most complete. Supplies of water at convenient points, Babcock extinguishers and sufficient lengths of hose to reach all parts of the building. The station is also fitted with watchmen's registers, so that the company knows that all parts of the station are regularly visited. The station furnishes 58 arc and 800 incandescent lights to the mills and about as many more about town. The accompanying cut shows the general plan of station and the arrangement of the equipment.

The profile bust of Benjamin Franklin will appear on the one cent postage stamp of the new issue that will be placed on sale Oct. 1st.

The Relation Between Technical Schools and Electrical Industries.*

BY PROF. G. D. SHEPARDSON.

The rapid growth in the number and extent of the applications of electricity in modern life has excited the wonder of all. The amount of capital invested in electrical interests in the United States is probably not less than $2,000,000,000. The number of persons finding employment is some hundreds of thousands. New discoveries are being made continually, and new industries are being built upon them. Each new line of industry stimulates others, and the growth is electrical in a double sense.

The question is often asked: Where are the men obtained who manage these great interests? How can men be trained to superintend and handle such large central stations, electric railways, telegraph and telephone lines, manufacturing establishments and carry them on successfully? The men in charge, or most of them, were out in the business world long before the schools began to teach electrical engineering, and the number of graduates from such courses today is far less than the number of positions to be filled. How, then, are men found or trained for handling these concerns successfully?

The answers are various. Some are not carried on successfully. Mortgage foreclosures, receiverships and suspensions are not unheard of in electrical circles, and in many cases they could have been prevented by the employment of competent electricians.

The successful management of many electrical plants or manufacturing establishments requires a knowledge of men and business more than a knowledge of technical details.

Vast numbers of mechanical; civil and other engineers have turned with the flood, and, by hard study, harder experience, and, perhaps, still harder nerve, have picked up such knowledge of electrical matters as was necessary to make them successful constructing or supervising engineers of electrical plants. It is well understood that most of the applications of electricity require more mechanical knowledge than electrical. It is, therefore, comparatively easy for men already familiar with machinery to become electrical "experts," so-called, in a short time. Most of the electrical manufacturing works have more or less thoroughly organized shop schools or courses of work for training "experts" who are sent out to forestall or overhaul plants sold by the parent company. These men often accept positions with the local companies and remain in charge.

Most of the state universities and some other institutions of learning have organized departments of electrical engineering which are doing something to supply men who, after some practical experience, will be able to take positions of more or less ress responsibility.

The growth in the technical schools is something like that of the other electrical industries. Five years ago the institutions offering courses in electrical engineering might be numbered on the fingers of one hand. Now there is hardly a state that does not boast one or more schools offering such courses on paper at least.

It is worth noting in this connection that the greatest advances in different electrical fields are being made by college men. Sir William Thomson's mathematical powers and skill in the use of laboratory instruments made it possible to operate the first trans-Atlantic cable. The inventors of the telegraph and telephone are generally known as Prof. Morse and Prof. Bell. Recent investigations of the possibility of telephoning across the ocean have all been made by college graduates, adepts in mathematics. The recent developments in transmission of power by alternating currents are almost entirely due to college men, whose mathematical investigations were tempered with practical experience.

The technical schools are more and more emphasizing the fact that success in engineering may be won only by hard and unceasing work, and each one must learn theory and practice together. He must temper his theory with practice; he must govern his practrice by theory.

The students are urged to spend their summer vacations of three months in electrical factories, repair shops, electrical light and railway stations, in wiring or wherever opportunity may offer to obtain actual experience in practical work. Under favorable circumstances they are urged to continue their practical experience a full year before returning to complete their technical course. Those who follow this plan find that they have a better appreciation of the work in the laboratory and lecture rooms, and when they graduate are far better prepared than those who do not obtain such practical experience during their course.

We may next inquire, What are the desirable relations between the technical schools and the men engaged in electrical business? Relations involve two parties and should be mutual. It is believed that the mutual relationship between the technical schools and the electrical interests has not received the attention it deserves.

Speaking first from the standpoint of the schools. We desire to help the electrical interests in this section of the country in every possible way. That is why the electrical engineering departments were established and that is why men are devoting their lives to this department. We aim to be of service in the following ways: By helping to educate men who will become efficient superintendents of local electrical companies, who will improve and maintain efficient service in electric light and power stations in telephone and telegraph exchanges and similar places, who will help raise the standard of construction and repair work, who will help develop new industries and who will be of good service wherever they may locate.

To older men who have had more or less experience in practical work, and who desire to improve themselves, the facilities of the libraries, laboratories and class rooms are extended. Every possible opportunity is offered to men of mature years to carry on any work within the scope of the university for which they are prepared.

The schools have done and are doing much to solve problems and to carry on investigations that are beyond the facilities of the factories or that would consume too much time, space and money. The schools are prepared and are doing good service in providing men and apparatus for making expert tests of efficiency of operation of central stations, machinery and other equipment. Testing bureaus for standard inquiry, measuring instruments, and for other expert tests are being established in connection with many of the laboratories.

Lawyers, inventors and investors often find it of great advantage to be able to look to the state university to obtain disinterested and reliable expert opinions from competent men who are unbiased by any connection with local or distant manufacturing or other electrical companies.

To sum up, we say we are trying to be of service to you in every way possible. If you have suggestions or criticisms they are welcome. We are for use, you are invited to use us.

It would be more fitting, perhaps, for some one actively engaged in business to discuss the other phase of the subject—the relation of the industries to the schools. Some points may be mentioned.

We are pleased to acknowledge the encouragement given us in finding positions for graduates and for students. These men come to you as helpers and not as supplanters trying to push out some one else. They are not as a rule conceited, but have learned that there is much that they do not know, much they can learn from those who have not been to college. They are anxious to learn and generally have a good share of common sense to start with. The schools would be more useful if the men in business would use them more as employment bureaus. If you send to the technical school when you have a vacant position to fill or a chance for a young man to get a start in practical work, past experience indicates that it will prove to be to your advantage.

You can help the school by sending them samples or specimens of results of peculiar accidents, samples from your scrap heap, showing how different material and apparatus stand use and abuse, pieces of discarded apparatus, with reasons for disuse, instruments or other articles that are of historical interest as showing the development. Such articles would be welcome additions to our growing collections, which are of great value in educational work.

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* Abstract of paper read before the Northwestern Electrical Association, St. Paul, July 18, 1894.

It would be useful if you would inform us from time to time of special problems that rise in your work—possibly we might help you.

Lastly, if you can help others to obtain a more thorough education by sending them to the university or by giving them opportunities to work with you, it will be in the right direction.

The Everett Railway and Electric Company.

The town of Everett, Wash., is situated on a peninsula about four miles long and one and a half wide, formed by the Snohomish river, which empties into Puget sound at this point. The town is largely owned by the Everett Land Co., a syndicate of New York capitalists, whose intention is to build up a large industrial city at this point. This company has recognized the fact that a well developed railway system and electric light plant is a great thing in building up a town.

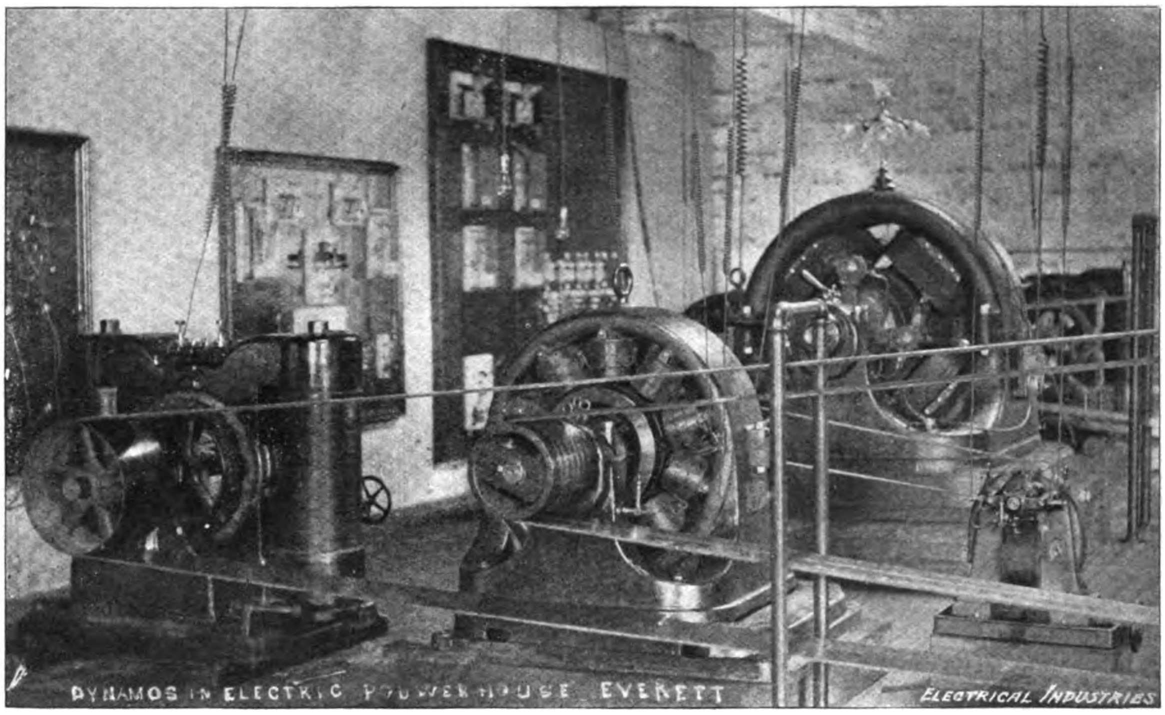

FIG. 1.—THE EVERETT RAILWAY AND ELECTRIC COMPANY.

Although the line runs at present through a considerable unsettled territory, it has been well laid out and will be a profitable investment. It binds together the manufacturing works that have been established about Everett, and gives a means of rapid transit between these points. One section of the line runs from the wire nail works, located on the sound, directly across the peninsula to the river. Two lines branch off half way between these points, one of which goes south about two miles to a large paper mill, and the other goes north to a smelter and reduction works and the Pacific Steel Barge Works.

The company was chartered in January, 1893. The stock was taken by eastern capitalists, and the construction of the plant was let to J. L. Colby of 36 Wall street, New York. Prof. Leo. Daft, who has for years been connected with railway work, being a pioneer in early construction, was the constructing engineer. The road and lighting plant was completed in July and turned over to the operating company. The officers of this company are as follows: President, Mr. S. Duryee; vice-president, Mr. G. Colby; secretary, H. A. Schenck; treasurer and general manager, A. R. Whitney, jr. The chief engineer of the station is E. J. Darling, who set up the engines and dynamos and has since been in charge of the station.

The power station is of brick with a truss roof and measures 97 by 56 feet. The boiler-room is 32 by 56 feet. The engine-room contains three cross compound Ball engines, from the Ball Engine Co., Erie, Pa., of the following sizes: 125 horse-power, 150 horse-power and 200 horse-power, exhausting into Barr surface condensers, pumping salt water through 700 feet 8-inch pipe and about 18 feet lift. In the cellar with the condensers are grease extractors and oil filters.

The electrical equipment for the railway and incandescent lighting service consists of apparatus of the Westinghouse Electric & Mfg. Co. The machines are as follows: One 225 ampere Westinghouse multipolar railway generator, and two 1,000 light Westinghouse alternators. The arc lighting equipment consists of three 50 light dynamos, manufactured by the Standard Electric Company, Chicago. The boiler-room contains four return tubular boilers, 16 feet long and 72 inches in diameter, with 82 four-inch tubes, manufactured by the Washington Iron Works, of Seattle. Fir and spruce is used for fuel. The feed water is obtained from springs in rear of power house, or in case of emergency from the city mains.

The hot well and two Barr feed pumps are located in boiler-room. Directly off the engine-room is a small store-room and engineer's office, measuring 10 by 10 feet, and a work-room, 10 by 40 feet. Car-house located, two blocks south of power-house, measures 57 by 100 feet, is of brick and wood, two stories high, and contains two tracks, each having a capacity of three cars with pits under tracks. On the first floor is also located the office. Second story is for a store-room and rewinding-room. The rolling stock consists of five cars made by American Car Co., with 16 feet bodies and two 20 horse-power Westinghouse motors.

The line consists of seven and four-tenths miles of double track with a maximum grade of nine per cent, extending for a distance of 250 feet. The accompanying engravings show interior views of the station. The arrangement of the dynamos and engines is shown, and also the location of the three switchboards.

Electric Power on the Chicago City Railway.

The engineers of the Chicago City Railway have given a considerable attention to the use of electricity in connection with the power plants of this large street railway system. When a number of the lines were changed from horse to electric an electric plant was erected at Fifty-second street where is also the cable power house which operates the cable line on State street from Fifty-second street to Sixty-third street. A 600 horse-power Westinghouse motor is to be substituted for one of the engines and the cable is to be driven by the motor, which will receive current at 500 volts from the electric plant. The electric plant is of ample size to run several such motors besides the electric lines which it now operates. It is estimated that this change will effect a saving of from $25 to $30 per day. Should it prove as satisfactory as expected power will be transmitted to other stations and the small steam plants will be abandoned.

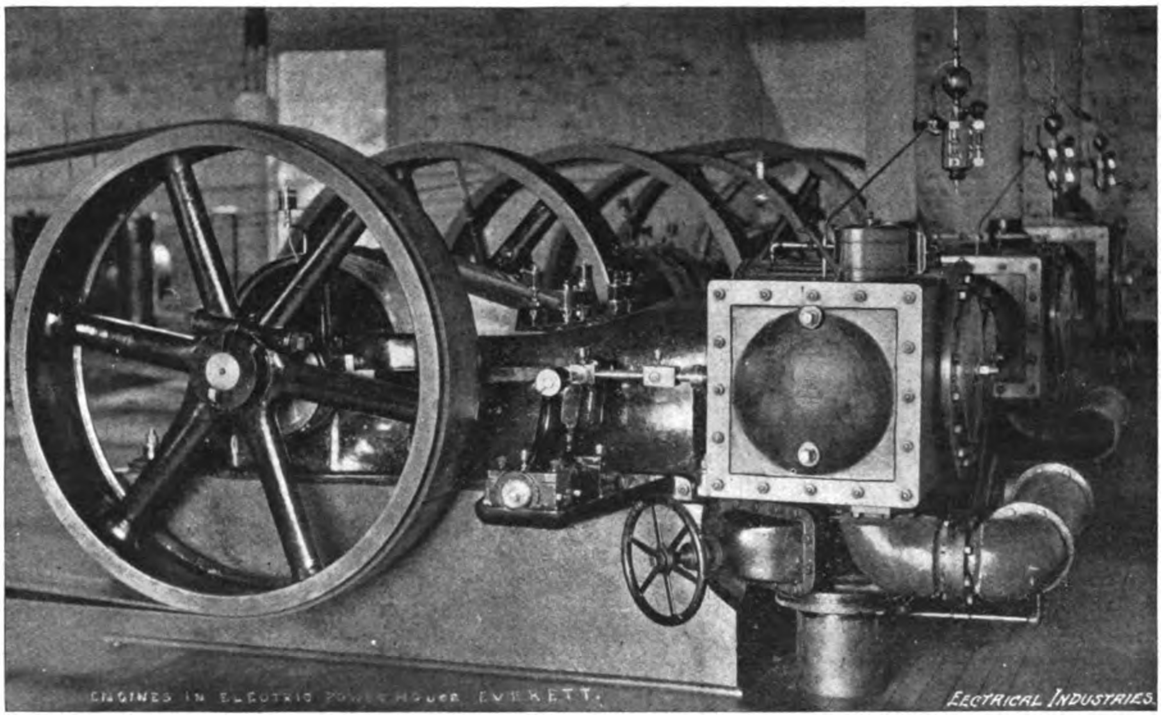

FIG. 2.—THE EVERETT RAILWAY AND ELECTRIC COMPANY.

At the different barns and shops of the road there are a number of small steam plants running elevators, feed cutters, etc., which can be operated much more economically by electric motors. This power service as well as the lighting of the building will be supplied by the electric power station. When the lines which it is now expected to equip with electric cars are completed, there will be some 130 miles of electric road in this system. The difficulty of securing the necessary permits to change the motive power on many of the lines has prevented the work being pushed this summer.

The new electric fountain in Shenley Park, Pittsburgh, it is said, will be one of the finest ever built. The electrical equipment is being installed under the direction of Mr. Meissner, of the Washington Electric Company.

Facts or Not Facts.

In a recent issue of the New York Evening Post appeared a communication from Mr. M. J. Francisco, in which he calls attention to several statements of Prof. Ely, of the University of Wisconsin. The following is from Mr. Francisco's letter to the editor: "He has published a text-book for the use of colleges and universities entitled 'Outlines of Economics.' In this, unfortunately, the author has drawn freely upon fiction, and quoted figures which cannot be sustained and which never existed except in his own fertile imagination. He devotes considerable space to municipal ownership, saying:

"The management of municipal service in lighting has proved more efficient than that of private companies.... in the matter of expense we can consider only certain cases where both systems have been tried and made comparisons possible. This we find especially in municipal service. In nearly every case on record in which the two systems have been successively tried there has been a saving of expense under public ownership, sometimes a very great saving, and that too, without a reduced efficiency. More often, especially in the case of electric lighting plants, municipal ownership has been tried at the outset, and comparisons made with towns similarly situated show an almost invariable advantage, usually very great, in favor of the city plants.

In 1892 Rutland, Vt., paid $280 per light per year; many private companies, of course, work more reasonably. The statement is then made that "thirty-nine cities furnish their own lamps at an average cost, including interest, wages and depreciation, of $77.68; allowing for this difference public lighting secured a saving of over 30 per cent as compared with private lighting."

When it is known that Prof. Ely reported the cost of lights furnished by a private company in Rutland, Vt., at $190.60 per lamp per year more than was actually paid, the insincerity and sophistry of his argument are apparent. Rutland has used lights from twilight to midnight, and has paid on an average for the past five years $89.40 per lamp per year, burning every night in the year; it also used eight lights which were burned all night, for which it paid 50 cents per night. The writer has approved every bill for lights paid by the city of Rutland during the five years referred to, therefore he knows whereof he speaks and does not rely upon guesswork or hearsay evidence."

Cost of Producing Electrical Energy.*

BY B. J. ARNOLD.

It was my intention when asked to prepare a paper upon this subject, to read before this convention, to point out some of the principal sources of loss in the operation of the present central station, and afterward to assume an ideal plant, designed in accordance with the latest practice, and show at what price per kilowatt hour the average station could deliver electrical energy to the consumer.

After the paper was partially prepared on this basis, Mr. R. E. Crompton read before the Institution of Electrical Engineers of London a paper covering practically this ground, in which he shows that with coal having a calorific value of 14,500 B. T. units, and with boilers capable of evaporating 12 pounds of water at a pressure of 150 pounds, and the losses so proportioned that 2½ pounds of this coal will evaporate 25 pounds of water, that a kilowatt hour can be produced for three cents and delivered to the customer for six cents leaving a profit of three cents over and above all operating expenses and interest on the investment. He figures that an average of 20 pounds of steam per kilowatt hour is all that would be required for actual service.

	Direct Current.		Direct Current with Accumulators			Alternating
	Elberfeld.	Hamburg.	Barmen.	Hanover.	Dusseldorf	Cologne.
GENERAL DATA.						
Fifty watt lamps capable of being supplied from the works	10,000.	11,600.	4,500.	12,000.	12,000.	13,600.
" " " " " " " " mains	12,000.	12,000.	6,500.	23,000.	23,000	24,000.
Available power in kilowatts	500.	980	225.	600.	600.	680.
EXPENSES OF FIRST ESTABLISHMENT.						
Installation capital, in dollars	272,829.96	473,912.90	204,425.53	504,176.51	557,194.58	472,500.58
Specific expenditure, in dollars per kilowatt	545.53	816.93	908.50	785.70	926.35	693.55
" " " ". lamp	24.25	31.43	31.53	39.28	46.32	34.68
RECEIPTS AND EXPENSES.						
Duration of working, in years	5.	4.	5.	2.	1.	1.
Total receipts, in dollars	46,281.80	112,245.49	23,995.08	65 002.22	54,710.04	54,738.65
Receipts, per cent. of the capital	20.5	23.68	11.74	15.8	9.8	11.5
Total expenditure, in dollars	17,498.99	26,568.21	8,365.67	18,370.92	15,328.13	20,460.21
Expenditure, per cent. of the capital	6.41	5.62	4.9	4.46	2.72	4 07
Rough total profits, in dollars	28,782.81	85,677.28	15,629.43	46,621.30	39,381.91	34,278.44
Profits, per cent. of the capital	14.09	18.05	7.65	11.34	7.	7.2
EXPENSES—COST.						
Total energy in kilowatt hours, produced	313,438.	542,900.	114,996.	452,520	484,111.	....
" " " " " distributed	305,794.	513,183.	122,026.	365,114.	337,285.	307,074.
Efficiency of the mains, per cent	97.5	94.5	84.16	80.69	69.68	....
Energy in watt hours per lb. coal, produced	....	148.	104.	219.	185.	....
" " " " " " distributed	....	140.	90.	181.	129.	71.
Salaries in cents, per kilowatt hour, produced	2.44	1.80	3.28	1.73	1.63	....
" " " " " distributed	2.52	1.92	3.90	2 15	2.33	2.93
Cost per kilowatt hour in cents, produced	5.57	4.91	5.76	4.05	3.15	....
" " " " distributed	5.70	5.18	6.85	5.02	4.54	6.65
Mean selling price in cents per kilowatt hour, including all expenses	18.29	21.86	19.65	17.79	16.20	17.81
Charge without deduction for the kilowatt hour, in cents	17.65	....	17.65	17.90	20.95	16.96
Price for cubic feet of gas, consumption above 3,000 cubic feet, cents	.11	....	.12	.195	.103	.081
CO-EFFICIENTS OF UTILIZATON—DURATION OF LIGHTING.						
Number of 50 watt lamps installed	11,100.	14,000	7,325.	13,642.	16,623.	15,329.
Maximum power utilized in kilowatts	400.	462.	139.	415.	309.	325.
Ratio of power utilized to power available	0.80	0.79	0.61	0.48	0.51	0.50
Duration of lighting, in hours, per annum	569	693.	325	529.	419.	422.
EMPLOYMENT OF ACCUMULATORS.						
Energy expended for the charge, in kilowatt hours	....	....	59,573.	194,733.	279,506.	....
Energy furnished by the discharge, in kilowatt hours	....	....	42,584.	154,836.	210,561.	....
Industrial efficiency of the accumulators, per cent	....	....	71.5	79.4	77.5	....
Ratio of energy supplied by the accumulators to the total energy distributed, per cent	....	....	35.	42.3	62.	....
Loss in the accumulators, per cent. of the total energy distributed	......	....	14.	11.	13.	....

TABLE NO. 1.—COST OF PRODUCING ELECTRICAL ENERGY.

Mr. Crompton's paper having covered practically the ground I had mapped out, has led me to abandon my original plan, in place of which I will present to you today the records of a number of central stations operating in this country and Europe from which you can, by comparison, ascertain whether your stations are doing as good service as they should. I will endeavor also to suggest ways in which the earning capacity of stations now running can be increased.

The losses between indicated and electrical horse-power in a fairly well-designed high speed, belted, direct current station are about as follows: Engines 10 per cent, belts 4 per cent, dynamos 10 per cent, line 10 per cent, making a total commercial efficiency of 70 per cent.

In alternating direct belted plants the losses on engines, belts and dynamos are practically the same as given above. The losses in the primary circuit are usually 5 per cent. Where there are many small transformers, and when working underloaded, as they usually are for a large portion of the time in small central stations, the average loss will be about 10 per cent, although when they are working at their rated load they will give an efficiency of 93 per cent to 95 per cent. The loss on the secondary wiring is usually 2 per cent. Combining these losses we find the average commercial efficiency of the alternating plan to be 65 per cent. In stations operating large engines belted to a countershaft the losses are practically the same as given above, except that the loss between the power delivered by the engine and the power delivered to the generators, is usually about 20 per cent, making the commercial or industrial efficiency of the above systems 58 per cent and 52 per cent, respectively, although there are many cases on record in which the losses are far greater than these, caused by unsoldered joints in the line construction, or defectively designed and operated machinery.

Table No. 1, published recently in L'Industrie Electrique, was prepared by Mr. J. Laffargue. I have reproduced it here, as it contains the most complete information regarding foreign central stations that I have been able to secure. The stations are all located in Germany; two of them, those at Elberfeld and Hamburg, being direct current plants, the one at Cologne an alternating station, and those at Barmen, Hamburg and Dusseldorf direct current stations with accumulators as auxiliaries. The table enables us to compare the relative merits of the three systems, and as will be noticed, the alternating station at Cologne produces 71 watt hours per pound of coal, and delivers a kilowatt to the customer for 6.65 cents. The station at Hanover produces the greatest number of watts per pound of coal, viz., 219, and delivers a kilowatt hour to the consumer for 5.2 cents, while the best result of all is shown by the station at Dusseldorf, producing, as it does, 185 watt hours per pound of coal and furnishing a kilowatt to the consumer for 4.54 cents. This would seem to indicate that there is an advantage in using accumulators.

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*A paper read before the Northwestern Electrical Association, St. Paul Minn., July 19, 1894.

It is also interesting to note that the average commercial efficiency of the accumulators is 76.1 per cent.

Mr. Laffargue adds that the following percentages are allowed for depreciation: 1½ to 2 per cent on the buildings; 4 to 5 per cent on the boilers and engines, and 6 per cent on the acculators; 3 per cent on the mains, and 8 to 10 per cent on the various auxiliaries of the plant. These figures are about correct for practice in this country, except on the accumulator question, and as there are now numerous strong companies entering the field in this country, who are willing to guarantee to maintain battery plants for 10 per cent per annum, it is possible that we can soon reach the state of perfection in the line that is indicated by these figures.

In comparing the figures on a basis of cost per kilowatt hour delivered to the consumer, the loss in the mains at the various stations should be taken into consideration, as it will be noticed that at Dusseldorf the loss between the station and the consumer is over 30 per cent, at Hanover 20 per cent, Barmen 15 per cent, while at Hamburg and Elberfeld it is but 5½ per cent, and 2½ per cent respectively. Were these allowances made. it would probably bring the cost at Dusseldorf much below the present figure, but not knowing the exact conditions it was impossible to make the proper allowance in this paper.

	STATION	H P CAPACITY	KILOWATT CAPACITY	HOURS OPERAT PR DAY	WATT HRS PER DAY	COAL KIND USED	COST COAL PR TON	WATT HRS PER LB COAL	COST COAL PR K W HR	COST OTHER EXPS K W HR	TOTAL COST PR K W HR DEL'D TO CUST
									cents	cents	cents
DIRECT CURRENT	1				684 600		$2 53	114	1 11	4 94	6 05
	2				434 303		3 01	88	1 70	4 06	5 76
	3				305 300		2 57	107	1 20	5 16	6 36
	4				299 610		2 47	122	1 01	4 72	5 73
	5				194 150						6 35
	6				140 000		2 55	108	1 18	5 76	6 94
	7				126 730		3 15	53	2 96	5 92	8 88
	8				125 203		1 94	71	1 36	3 37	4 73
	9				85,100		1 43	65	1 10	3 61	4 71
	10				53 700		2 20	53	2 08	3 05	5 11
	11				50 300		82	48	85	5 07	5 92
	12				47 000				2 24	4 69	6 93
	13				37 100		2 26	82	1 38	5 71	7 09
	14				33 600		2 38	66	1 80	4 02	6 22
	15				33 400				11		6 19
	AVERAGES						2 28	81 5	1 46	4 65	6 23
DIRECT CURRENT	16	90	67 045	24	1 609 070	bitm slack	assumed $1 50	150	50		
	17	25	18 400	15	276 000	" "	1 50	46	1 63		
	18	37	27 450	10	214 500	" "	1 50	56	1 34		
	19	17	12 720	14 7	187 860	" "	1 50	64	1 17		
	20	18	13 425	6 5	87 230	" "	1 50	62	1 21		
	21	20	14 560	5 0	72 800	"	1 50	48	1 57		
	22	48	35 659	7 5	267 375	bitm block	3 00	76	1 98		
	23	33	24 605	10	246 057	" "	3 00	46	3 27		
	24	20	15 000	9	135 080	" "	3 00	56	2 68		
	25	20	15 200	6	91,360	anthr pea	4 50	65	3 46		
	AVERAGES							66	1 91		
ALTERNATING CURRENT	26	26	19 000	8	152,000	bitm slack	1 50	104	72		
	27	203	220 000	9 5	2 090 000	bitm block	3 00	52	2 88		
	28	66	49 220	16 0	785 420	bitm "	3 00	121	1 24		
	29	38	28 000	12 0	336 000	" "	3 00	96	1 56		
	30	38	22 000	11 0	242 000	" "	3 00	76	1 98		
	31	30	22 300	14 0	312,666	anthr pea	4 50	108	2 09		
	32	25	18 480	6 0	110 880	"	4 50	110	2 05		
	AVERAGES							95 3	1 79		
COMBINED SYSTEMS	33	101	134 780	21 0	2 843,760	bitm block	3 00	104	1 44		
	34	446	332 150	24 0	7,971,600	anthr screen	1 50	208	36		
	35	18	24 100	15 5	373 520	bitm slack	1 50	111	68		
	AVERAGES							141	83		
GERMAN PLANTS	Elberfeld	(direct current station)			313 438						5 70
	Hamburg				342 900			140			5 18
	Cologne	(alternating cur station)			387,274			91			6 65
	Barmen	(direct cur with accumulator)			144 996			104			6 05
	Hanover	" " "			452 526			219			5 02
	Dusseldorf	" " "			484 111			185			4 59

TABLE NO, 2.—COST OF PRODUCING ELECTRICAL ENERGY.

The first part of table No. 2 marked "Direct Current," was prepared from reliable information on file in the writer's office, and is the result of the operation of fifteen large direct current stations located in different parts of the United States. The three succeeding parts of the table marked "Direct Current," "Alternating Current" and "Combined Systems," have been compiled from information secured from the report of the committee on statistics of the National Electric Light Association, presented at its last meeting, and figures were chosen only from such stations as seemed to bear evidence of careful compilation. This report did not give the cost of coal per ton, nor the cost of coal per kilowatt hour, but simply gave the watt hours produced per pound of coal. By assuming a price per ton on the coal we have deduced the costs per kilowatt hour which are given, but not having the information necessary to ascertain the operating expenses or fixed charges, the total cost per kilowatt hour delivered to the consumer is omitted.

In general, however, I will state that the expense of operating in central lighting stations, is approximately as follows:

Fuel	23.15	per cent.
Labor	21.20	"
Lamps	7.75	"
Repairs	13.10	"
General expenses	23.15	"
Other expenses	11.65	"
Total	100.00	

24 HOUR TEST ON COAL.	Avr'ge Gauge Pres. Lbs.	Temperature Feed Water.	Temperature Escaping Gases.	Duration Hours.	Average Watts. Railroad Circuit.	Average Watts. Incand'st Circuit.	Average Watts. Arc Circuit.	Horse Power Electrical.	Horse Power Indicated.	Per Cent. Loss.	Total Fuel Lbs.	Total Ash Lbs.	Total Combustible Lbs.	Cost Fuel.	Water Total Used Lbs.	Evaporation Per Hour Lbs. Actual Evaporation.	Evaporation Per Hour Lbs. Factor Evaporation.	Evaporation Per Hour Lbs. From and at 212°	Evaporation Per Hour Lbs. Per Lb. Fuel Actual	Evaporation Per Hour Lbs. Per Lb. Fuel Equivalent 212°.	Com. H.P. 34½ lbs. water, hour 212°.	Cost per commercial horse power per hour fuel.	Cost of fuel for period.	Total cost operations. includi'g labor	Total cost fuel and labor per kilowatt hour produced.
											Coal.														Cents.
Feb 2 10-20 A. M. to 4-10 P. M.	125	116°	640°	5.833	39215	......	......	52.56	.. ..	. ..	3264	11.02 per cent.	......	Indiana block coal at 2.60 per ton.	20626	3536	.....	4052	......	.. ..	117.5	......	$3.72	$7.11	3.10
4-10 P. M. to 5-45 P. M.	....	128°	680°	1.583	34100	34650	9180	104.46	.. ..	...	937		......		7019	4433	....	5082	......	......	147.3	......	1.27	2.28	1.85
5-45 P. M. to 8-20 P. M.	......	118°	......	2 583	41360	38940	24140	140.00	......	...	2502		......		16849	6522	......	7474	......	......	216.6	......	3 04	4.13	1.53
8-20 P. M. to 12-00 M.	......	116°	......	3 666	26620	27170	24140	104.46	......	.. ...	2874		......		21028	5735	....	6571	......	......	190.5	......	3.79	5.33	1.87
Feb. 3. 12-00 P. M. to 5-50 A. M	......	110°	620°	5.833	2572	10611	8160	36.56	......	...	3952		.		27845	4774	......	5471	......	......	158 6	......	5.03	6.26	3.96
5-50 A. M. to 7-10 A. M.	.....	116°	......	1.333	24640	16500	......	55 14	....	......	1049		....		4544	3409	......	3907	....	......	113.3	......	.82	1.40	2 52
7-10 A.M. to 10-20 A.M.	125	118°	......	3.166	40480	.....	......	54.26	......	......	1019		..		14437	4559	......	5225	......	. .	151.5	....	2.60	3.97	3.08
For entire run......... ..	125	114°	635°	24.00	......	.. ...	......	.....		..	15597	1719	13878	$20.27	112348	4680	1.146	5364	7 20	8.25	155 5	$.00543	$20.27	$30.48	2.45
24 HOUR TEST ON OIL.											Oil.														
Feb. 6. 10-20 A. M. to 4-50 P. M.	125	126°	480°	6.500	29631	... .	.....	42.2	63.3	33.2	1912	......	.....	C'st oil per gal $.017865 Cost oil per lb $.000253.	23896	3677	.. .	4184	.....	......	121.3	......	4.98	8.80	4 31
4-50 P. M. to 5-55 P. M.	......	124°	....	1 083	32436	35420	9180	106.0	137.0	28.6	371	......	......		4944	4565	......	5195	......	....	150.6	......	1 03	1.81	2 13
5-55 P. M. to 8-20 P. M.	......	128°	520°	2 416	33573	39160	24140	128.0	158 0	19.0	1091	......	......		15244	6310	......	7180	......	......	208.1	......	3.18	4.19	1.58
8-20 P. M. to 12-00 M.	......	......	......	3.666	24192	27170	24140	100 0	130 0	23.2	1691	......	......		10364	5282	......	6011	......	......	174.3	......	4.04	5.58	2.03
Feb. 7. 12-00 M. to 5-50 A. M.	......	116°	......	5 833	660	16500	9180	35.3	86.9	59.4	1992	......	......		23889	4096	......	4661	......	......	135.1	......	4 98	6.20	4 06
5-50 A. M. to 6-07 A. M.	.....	124°	......	.283	23980	16500	9180	77.0	107.0	28.0	115	......	......		1648	5824	......	6627	......	......	192 1	......	34	.40	2 50
6-07 A M. to 10.20 A. M	125	118°	......	4.216	33920	......	.....	42.2	63.3	33.2	1398	......	......		14971	3551	......	4041	......	......	147.2	......	3.12	$4.95	3.72
For entire run......	125	122°	.....	24.000	......	.....	.....	.....	.....	.....	8570		. .	$21.68	103956	4332	1 138	4930	12 13	13.80	142.9	$.006324	$21 67	31.93	2 83
Feb. 14 and 15 24 HOUR TEST Park Co Coal.		......	....	24.00	.....	..	..	.....	.....	.....	16930	2659	14271	$2.15 T. $18.20	101854	4244	As-s'med 1.138	4829	6.016	6.846	140.0	$.005417	$18.20	$28 43	....

TABLE NO. 3 —CO T OF PRODUCING ELECTRICAL ENERGY.

The last portion of table No. 2 is a synopsis of table No. 1. Table No. 3 is the result of three tests made under the direction of the writer on a combined electric and lighting station, to ascertain the relative economy on oil and coal for fuel. Inasmuch as the information is quite complete it has been thought advisable to insert it in this paper. The station consists of two compound condensing engines, coupled directly to a line shaft. This shaft runs two 90 kilowatt railway generators, two 16 kilowatt arc light machines, two alternating incandescent dynamos of 30 and 50 kilowatt capacity respectively, or a total capacity of 392 kilowatts. The station is delivering but 1,248 kilowatt hours, showing that it is running considerably under loaded.

Figure No. 1 is a diagrammatic representation of the load during the 24 hours' run. The spaces between the vertical lines represent time and the horizontal lines horse power. The upper heavy line represents the total indicated horse power in the cylinders of the engine. The dotted line immediately below this represents the total electrical horse power delivered on the switchboard. The difference between these two lines represents the power lost in overcoming friction of engine, line shafting and the electrical losses in the dynamos. The third dotted line from the top represents the electrical horse power required by the arc and incandescent lights, and the lower dotted line represents the electrical horse power required by the arc lights alone.

Teferring to table No. 3 it will be observed that the test began at 10:20 A. M. and continued for 24 hours. As the load in this station varied greatly, one of the objects of the test was to ascertain the cost of producing power during the different periods, and the right hand column in the table shows the total cost per kilowatt hour of the power thus produced.

As a matter of fact the following statement shows approximately the average amount of power demanded from electric motors when running on various kinds of work: Wood working machinery, 40 per cent. of rated capacity of machines in the plant; elevators, 80 per cent; printing presses, 55 per cent; machine shops, 40 per cent. or an average of about 55 per cent. On this basis this plant could drive safely 160 horse-power in addition to its present railroad load, which, at 2 cents per horse-power hour would bring an additional revenue of $33 per day, and deducting $9, the cost of fuel, leaves $24 per day additional net profit which this plant can be made to earn, provided the full capacity of the motors is paid for.

In case the additional load for electric motors is not available this extra 90 horse-power could be utilized in driving an ice plant. In practice it takes about 2 horse-power 24 hours to produce a ton of ice, and on this basis the available capacity of this plant would produce 20 tons of ice, which would sell for at least $3 per ton, making an additional revenue of $60 per day for the plant, and after deducting for extra fuel, labor and depreciation, leaves $40 per day.

The cost of ice-making plants is about as follows, per ton of output in 24 hours:

1 ton	$2,700
2 "	2,650
6 "	1,216
12 "	992
20 "	875
40 "	800

While the addition of an ice plant to an electric light plant may not be particularly desirable in stations throughout the Northwest, there is no doubt that there are many stations throughout the Southern and Western states where such plants could be installed to advantage.

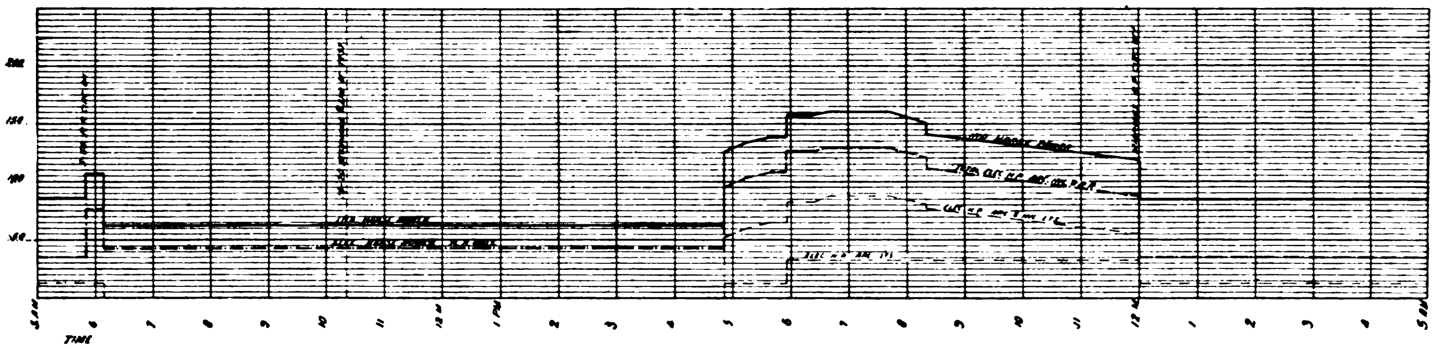


FIG. 1.—COST OF PRODUCING ELECTRICAL ENERGY.

The railway portion of this station operates from four to six cars, and during the time of the test but four cars were in operation. The cars started at 5:50 A. M. and ran until 12 o'clock midnight, and the lighting load was added as indicated by the figure.

The division in the table shows the principal variation in the load, and it is interesting to note the change in cost per kilowatt hour produced, depending, of course, as it does upon the quantity of current delivered, as the cost remains practically constant, with the exception of the fuel. From 7:20 A. M. to 4:10 P. M., when the railway load is being operated, the cost averages 3.1 cents per kilowatt hour, and from 13 o'clock midnight until 5 A. M. the cost per kilowatt hour is 3.96 cents, while during the heavy load, from 5 P. M. until midnight, the average cost per kilowatt hour is but 1.75 cent, and after deducting the labor, which is a fixed charge, the total cost per kilowatt hour for full load is but 1⅓ cent. After allowing for salaries, office expenses, loss in lines and depreciation in the plant, the figures show that this station is delivering current to the consumer for 6.4 cents per kilowatt hour, which corresponds fairly well with the figures given in table No. 2.

With a little calculation we see that this plant could have furnished 681 additional kilowatt hours, or over 90 additional horse-power in motors, for ten hours from 6 A. M. to 6 P. M., for an additional cost of but $9.00 for fuel, or at a cost of 1 cent per horse-power hour, and as a price of two cents per horse-power hour can be obtained for motor work there would be an additional revenue of $9 per day added to this station, assuming that all the motors were running fully loaded.

In closing this paper I will briefly call attention to the approximate results we are now getting from the different portions of power stations, and what we ought to expect from stations designed in the future.

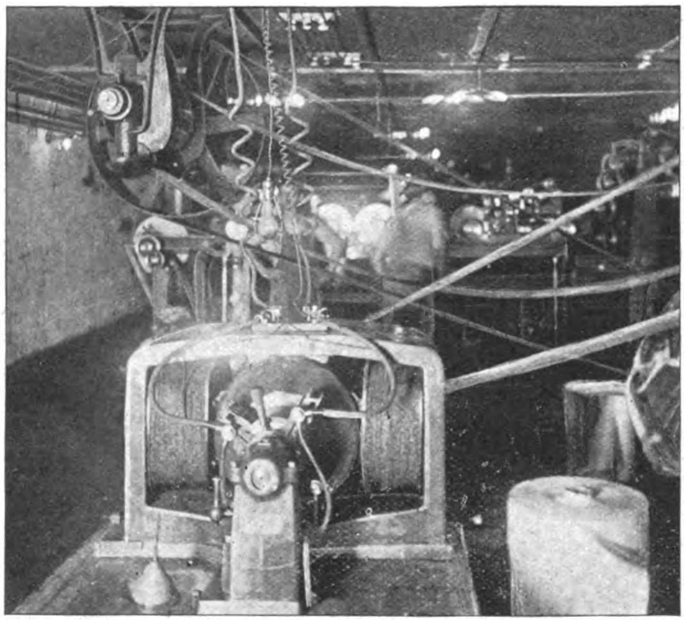
First—Boilers—A large number of stations running now are using boilers with plain furnaces, from which they secure an evaporation of 5 pounds of water per pound of coal. By the introduction of water tube or internally fired boilers or tubular boilers set in improved furnaces, we should secure an evaporation of 8 pounds of water per pound of the same fuel.

Second—Engine and Generators—While we now get an average commercial efficiency of 60 to 70 per cent in direct belted plants and 50 to 60 per cent in those using shafting, we can increase these efficiencies to 70 and 75 per cent, respectively, by the adoption of fewer and larger direct coupled units. This will not only reduce the cost of fuel and labor but will decrease the amount of real estate required and make the total investment less.

Third—While Europeans have recognized the advantage of the use of accumulators with batteries as auxiliaries in central station work, we have been slow to see this advantage, but the tendency now among American engineers and central station men is to look with favor upon this adjunct, and as there are many cases wherein a battery plant as an auxiliary can be made to pay well, the probability is that we shall see in the next five years many such plants installed. With a properly designed direct connected plant we may reasonably expect to deliver a kilowatt hour to the consumer in stations having a capacity of not over 1,500 kilowatts for 5 cents per kilowatt hour, which includes total cost of production and depreciation on the plant, but excludes interest on the investment and profit, assuming that a good quality of bituminous coal can be had for $2.50 per ton. In larger stations with cheaper fuel the cost can be brought to 3½ cents.

Eddy Motors in Press Rooms.

The accompanying cut shows an Eddy motor as used in the press room of the Chicago Abendpost for running the large presses which print the daily editions of that newspaper. In nearly all the large press rooms of the Chicago dailies electric motors are used, receiving the preference over other forms of power on account of their convenience, cleanliness and reliability. Ninety-three horse-power of motors are used by the above paper. The motor shown is a 40 horse-power Eddy and as will be noticed is a multipolar of the latest type. A one horse-power type C Eddy motor operates the typesetting machines. Current is obtained from the Chicago Edison mains. The large Eddy motor, which is slow speed, is used in place of a motor previously installed because it does away with a counter shaft. These motors were sold and installed by Kohler Brothers, who have in the past few years furnished electric motors for a large number of Chicago printing establishments. This motor, on account of its slow speed and compact form, two features which are especially important in press rooms, is receiving the preference. It is manufactured by the Eddy Electric Manufacturing Company.



EDDY MOTORS IN PRESS ROOMS.

World's Fair Awards on Wire.

The following awards have been made on wires in the department of electricity. The tests of wires is said to have been thorough and exhaustive, but the figures have not been made public:

W. R. Brixey, New York, N. Y. Group 126.—Class 769.
Insulated Wire for Electric Light Service. Award.
1st. Highest excellence in insulating qualities.
2nd. Durability of insulation under conditions found in commercial service.
3rd. Uniform high excellence in mechanical qualities of insulation.

Note.—This report is based upon the results of exhaustive tests approximating the various conditions to be met with in practice by insulated wires in electric light service.
D. C. Jackson, Individual Judge.
Henry S. Carhart, President Departmental Committee.

Okonite Co., New York, N. Y. Group 126.—Class 769.
Insulated Wire. Award.
(*a*) Rubber Insulated Wires for Electric Lighting.
1st. High excellence in insulating qualities.
2nd. Durability of insulation under conditions found in commercial service.
3rd. Uniform high excellence in mechanical qualities of insulation.

Note.—This report is based upon the results of exhaustive tests approximating the various conditions to be met with by insulated wires in electric light service.
(*b*) Lead Covered Cable for Underground Electric Light Service.
This cable has proved successful in commercial service.
Henry S. Carhart. D. C. Jackson.

New York Insulated Wire Co., New York, N. Y. Group 126.—Class 769.
Grimshaw White Core Insulated Wire. Award.
1st. Durability of Insulation.
2nd. Mechanical excellence of insulation.

Note.—This report is based upon the results of exhaustive tests approximating the various conditions to be met with in practice by insulated wires in electric light service.
Henry S. Carhart. D. C. Jackson.

Simplex Electric Co., Boston, Mass. Group 126.—Class 769.
Insulated Wires. Award.
These are good weatherproof wires.
Henry S. Carhart. D. C. Jackson.

Standard Underground Cable Co., Pittsburgh, Pa. Group 126.—Class 769.
Lead Covered Cables for Underground Electric Light and Power Service. Award.
This cable has proven successful in commercial service.
Henry S. Carhart. D. C. Jackson.

Norwich Insulated Wire Co., New York, N. Y. Group 126.—Class 769.
Lead Covered Cables for Underground Electric Light Service. Award.
This cable has proven successful in commercial service.
Henry S. Carhart. D. C. Jackson.

Department J, Electricity.
Only Award. 2446.

W. R. Brixey, New York, N. Y. Group 133.—Class 790.
Exhibit.—Telegraph and Telephone Cables, Underground, Aerial and Submarine. Award.
1st. Excellence of material and construction.
2nd. High insulation.
3rd. Reliability and durability demonstrated by records of prolonged service under exacting conditions.
M. O'Dea, Individual Judge.
Approved: Henry S. Carhart, President Departmental Committee.

J. A. Roebling's Sons Co., Trenton, N. J. Group 126.—Class 769.
Exhibit.—Bare Copper and Trolley Wire. Award.
1st. High conductivity.
2nd. Long lengths.
3rd. Great tensile strength.
4th. Uniform gauge.
M. O'Dea, Individual Judge.
Approved: Henry S. Carhart, President Departmental Committee.

Washburn & Moen, Worcester, Mass. Group 126.—Class 769.
Exhibit.—Bare Copper Wire. Award.
High conductivity.
This exhibit includes bare copper wire for lighting and power circuits, trolley wires and hard drawn wire for telephone circuits. B. F. Thomas, Individual Judge.
Approved: Henry S. Carhart, President Departmental Committee.

Electrical Industries.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

Advertising Rates upon application.

Among electricians and engineers there has been a great diversity of opinion regarding the commercial value of the storage battery. European engineers have so favored them that few central or power stations are without storage battery equipments, while on this side of the Atlantic the reverse is true. In the design of an electrical station in the two parts of the world this would be the most noticeable difference in the plans. The opinion of American engineers, however, seems to be changing. The recent contract made by the New York Edison Electric Illuminating Company, for a storage battery plant to be used in its lighting plant and the interest manifested by other companies, indicates that managers have a greater faith in the utility and commercial value of the storage battery in connection with lighting and power stations. Why America is so far behind the older countries in this respect is hard to determine, but when it has once been demonstrated that storage batteries are a commercial success in the large stations their adoption will be rapid. For certain purposes storage batteries are now used quite extensively, and new uses are constantly being found for them, but the cells generally used are small and as light as possible. In this respect they differ from those of foreign makers, whose cells are heavier for the same capacity. To this fact may be due a considerable of American prejudice. The batteries have been rated too high and an overload has been disastrous to the plates. A number of instances of this kind might be mentioned where the attempt to make use of batteries has resulted in ruined cells, and a disgusted customer, who did not fail to spread his opinion of storage batteries. Manufacturers are undoubtedly profiting by these experiences.

Reports show that with many central stations during the past year it has been a difficult matter to make the income meet the expenses of the station and dividends have not been thought of. With others business has not been satisfactory, and how to increase the revenue has been a serious question with the managers. If the greatest economy has been reached in the operation of the plant with the present load it is evident that either the load must be increased or additional work of some kind found for the equipment. An investigation of the station would in many cases reveal the following condition of affairs: A plant in operation for 24 hours, steam up and engineers and attendants on duty contінously; a maximum load for but a few hours and a surplus of power during the remainder of the day. The manager naturally looks for more customers for light and power. Customers desiring light only increase the load at the time when the station is already loaded and current for power at the standard rates cannot compete with other forms of power. Power customers are desirable because they are supplied during the day, and the manager, if he thoroughly understands his business, can undoubtedly make satisfactory rates which will secure customers for this more desirable form of power. The advantages of electrical power rightly presented to power users will almost always bring an increase of customers. A comparison of the cost per horse-power at the present load and the cost with a greater power load during the day will show that satisfactory rates can be made and the revenue of the station in this manner increased.

Many stations are so situated that an increase of lighting and power customers is not possible, and the equipment of the station must be used for some other purpose. Attention has been called to the advantages of operating ice making and electric plants together. The electric plant has its greatest load during the long winter nights, and the ice plant during the hot weather when the electric plant has a light load. The steam or power plant furnishes power for each and the same labor looks after both plants. Ice machines are manufactured of any size desired, and a plant may be put in for supplying a town with artificial ice or for a cold storage plant. Mr. B. J. Arnold gives some valuable figures on the cost of ice making plants and cost of manufacturing ice, in his paper read before the Northwestern Electrical Association, which possesses much valuable information for central station men.

Still another industry that has been tried in connection with central stations and is pronounced a success, is the supplying of exhaust steam for heating. There are a number of central stations running exhaust steam heating systems, and the opinions of the managers seem to be the same: that the stations would not pay were it not for this source of revenue. Like many other manufacturing establishments the profit is derived from the sale of the by-products. A net income of as high as $10,000, per year has been secured on an additional investment of $25,000, from a system of exhaust steam distribution. In the manufacture of gas it often happens that the revenue derived from the sale of the by-products pays for the manufacture of the gas, and the gas companies are the active competitors of nearly every central station. The electric lighting company if it intends to hold the field and establish a permanent and profitable industry, must utilize every available part of the station, securing by that means the greatest revenue for the least outlay.

The combination of refuse destruction and electric lighting has received some attention in England. It has been considerably discussed and should not be overlooked. The method of disposing of the refuse of a town or city will depend upon the situation of the town and other circumstances, but where destructors are used the waste heat can be used in the generation of steam. Whether this steam can be better utilized in the generation of electricity or in the manufacture of some other product will also depend upon circumstances. The fact that for the economical distribution of electricity the plant should be located near the center of the city, is opposed to such use. Where fuel is expensive and a plant can be conveniently located the combination of a refuse destroying and an electric lighting plant may be advantageous. A London contemporary gives some figures and conclusions regarding the establishment of such plants, as follows: "Careful measurements go to show that, with a water-carriage system of sewage, ash-bin refuse amounts to about four hundred-weight per head of population per annum. One pound of this refuse may be taken as having a heat value of one-thirty-second of a pound of coal. With a population of 32,000, therefore, 128,000 hundred-weight of refuse, having a heat value equal to 448,000 pounds (200 tons) of coal, will be obtainable. Assuming that, with that population, the lighting load would be 32,000 30-watt lamps for 1,000 hours per annum, or 960,000 units, the coal consumption would be, at seven pounds per unit, 3,000 tons per annum. The saving in fuel, therefore, by using the waste heat from the refuse destructors, would be 6.6 per cent. So that, in a case such as this, the general proposition may be laid down that the waste heat from the refuse destructors can be profitably utilized in connection with the electric lighting station, when, from other considerations, it is within 6.6 per cent as profitable to carry out the electric lighting from the refuse-destructor works site, as to establish a central station in any other position relatively to the town."

In another column will be found an article on the progress in gas motors for street railways from the consular reports of the present month. While the article is mainly devoted to the experiments of the owners of the Luhrig patents it incidentally refers to the present condition of the street railway industry in Great Britain as follows: "Notwithstanding the relatively dense population of Great Britain, only a small proportion of its tramways as worked at present by cables, steam locomotives, electricity or horse power, are really satisfactory to the public or pay regular dividends." The author looks for a remedy in the invention of a motor that shall be noiseless, independent of overhead or underground construction and cheap as regards initial investment and working expense. While we cannot dispute the possibility of such an invention it is hardly probable in the light of present knowledge in the near future. The gas motor to which he looks as the motor that will fill these conditions has not in the extended list of trials fulfilled these conditions. The history of the attempt to use gas motor cars on the North Chicago Street Railway shows that in this case street cars so propelled did not meet the requirements. The above company after an investment of considerable size in the equipment and large sums spent in experiment now has gas motor cars stored in its barns that it would be glad to find a purchaser for, and the cars are drawn by horses. Electricity which has demonstrated in the numerous roads throughout this country its advantages for the propulsion of street cars is to be adopted on these lines. It is undoubtedly the opinion of experts that the coming method of street car propulsion for our largest cities will be an electric system with underground conductors either in an open or a closed conduit. Such systems now possess every condition except that of initial cost and means will undoubtedly be found for reducing this. Electric lines seem to meet the ideas of the riding public which will always be greatly in its favor and which is something the gas motor has not done.

The city of Milwaukee and the Milwaukee Railway Company are at war. The strife seems to have started with the assessment for this year, which is almost three times that of previous years. One side gives the franchises of the company a value in the millions; the other side say they would not again accept the franchises as a gift. The company is evidently over-assessed and is not this year as well able to bear it as previously. The earnings have greatly decreased. The citizens of Milwaukee have had an excellent system of street railways and have enjoyed many privileges which other cities not so fortunate have not even hoped for, but these are being cut off. Vice-President Payne issued an order the first of the month withdrawing commutation tickets, and it is said the extensive system of transfers will be curtailed. The city council has proposed the purchase of the entire system, and has gone so far as to appoint a committee to investigate the property, find how much it should cost and the best means of raising the money. However, the fight still continues, the last difference of opinion being over the bed of concrete under the track. The company does not consider it is legally bound to put down any concrete, but has consented to put concrete on Grand avenue, where the street is torn up from the river to the alley between Fourth and Fifth streets.

Merchants and manufacturers are looking to the future more confidently. The feeling among business men has greatly improved and fewer evidences of the depression are apparent. The ranks of the unemployed have gradually thinned and there are now, it is believed, more men employed than at any time during the past twelve months. The railroad service of the country has resumed its accustomed activity, and sections where the greatest restlessness of the laboring classes has been manifest are quiet. Economy has been everywhere the rule and corporations as well as individuals have saved every expense, wearing last years clothes and allowing the cobwebs to multiply in the shops. Warerooms have grown empty and the supplies for the present and future needs must be manufactured. The number of new enterprises reported shows an increase and investors are more willing to place their money in manufacturing enterprises. With no assistance from congress the country has recovered by main strength. The passage of a tariff bill was too long delayed to benefit manufacturers, but it will give them greater confidence in future operations. As business in general improves the electrical industries will improve. Although several failures of electrical houses were reported for the month a better feeling prevails and a more active period is looked for.

Mail cars have been placed on the lines of the Atlantic Ave. Railway Co., Brooklyn. One-half of the car has been fitted for carrying and sorting the mail, and the other half is used as a smoking car. The cars are handsomely finished both within and without. Pigeon holes for distributing the mail, tables for sorting and canceling the stamps, pouch racks and hooks for holding the pouches open, are some of the equipments. There is also a box where letters may be mailed by persons who desire to hasten the sending. The system so far prepared is to be given a thorough trial, and if satisfactory will be greatly extended. It will be especially useful in carrying mail between the suburbs and the city.

An electrical apparatus is described by a London contemporary for the detection of petty thieves who steal goods displayed in shop fronts or goods that may be displayed within the store. The hooks from which the goods are suspended, are connected in an electric circuit in which there is also an electric bell. When the goods are on the hook the circuit is open, but should the goods be removed the circuit closes automatically, and the bell, which may be placed in any convenient part of the store gives the alarm.

Each hook is independent, and as many hooks may be used as desired. The wiring is concealed within the standard or support so that there is nothing in sight which would indicate the existence of the device. Suitable switches are provided so that when the hooks are not in use the circuit is opened. The system is very simple, and can be adapted to numerous places where such devices are needed. It can be used in clubs, cloak rooms, theaters, etc.

The Annual Clambake of the American Electrical Works.

Another successful reunion was added on Saturday, August 21st, to the many previous ones, for which the electrical fraternity is indebted to the American Electrical Works. In response to the invitations sent out by the company over 200 members of this industry gathered at Haute Rieve, the headquarters of the Union Club, and there engaged in various forms of amusement and out door sports, and when the bake was opened gathered around to enjoy the many good things for which this company is wellknown. A large tent had been provided under which the tables were placed. The usual game of ball was played, in which the Bostons seem to have had the advantage.

Mr. Chas. W. Price, of New York, was requested to act as toast master, and after a few remarks introduced the Hon. John C. Wyman, of Providence, who gave an interesting and amusing address. The toast, The American Electrical Works, was responded to by its president, Mr. Eugene F. Phillips, who expressed the pleasure that these annual gatherings gave him, and hoped that those present might be spared to enjoy many more. Mr. John I. Sabin, of San Francisco, also made some remarks, and was followed by Mr. A. F. Hibbard, of Chicago, whose entertaining song greatly amused the audience. Those present reached the rendezvous by various means; some going by special train, others by boat, and they returned as best suited their convenience. The fraternity was represented by men from San Francisco, Chicago and the various eastern cities. The welcome which Mr. Eugene F. Phillips, president of the company, extended to all, and the entertainment he never fails to provide, has made these clambakes an event which is looked forward to by all who have ever had the good fortune to attend.

Many souvenirs were carried away in the shape of photographs, etc, which will in years to come recall to mind the Sixteenth Annual Clambake of the American Electrical Works.

The Petersen Electric Conduit System.

A company was recently incorporated, called the Petersen Electric Conduit Railway Construction Company, for the manufacture of underground electric conduits under the patents of Mr. H. Petersen, of Milwaukee. The incorporators of the company are Mr. A. E. Smith, Wm. Myert and J. E. Esch. It is said that the company mean business, and will proceed at once with the manufacture of the various parts of this system. This system of underground conduit was described and illustrated in a previous issue of ELECTRICAL INDUSTRIES, and is undoubtedly familiar, through the descriptions published to the reader. The conduit consists essentially of an iron conduit, having two compartments into one of which the slot opens, while the other one, which is separated by a movable slide, contains the electric conductors. It is shallow and does not require a deep excavation to accommodate it, and on this account the cost of constructing a system of this kind is not so very expensive. This second compartment, after the passage of the car, is automatically closed, thus excluding dirt, mud, etc. The system provides for a complete circuit, and such a system can therefore be economically operated. A suitable brush has been devised for sweeping out the conduit. It is intended to use steel rail conductors instead of the copper trolley wires used on the overhead system. These rails will be carefully insulated and will be more durable than light trolley wires. The company expects soon to equip a section of road to show the practical operation of the system.

Cushing & Morse.

The accompanying cut shows a view in the offices of the well-known firm of Cushing & Morse, who handle for the western trade Day's kerite wires and cables. As is evident, the firm has been interrupted in its business by the entrance of the photographer, and although not always so busy but what they are ready for a chat with customers the management of the large territory covered by this firm involves considerable work. This territory requires an immense quantity of wire annually. Wires or cables enter into every electrical installation and the demand for these goods is steady and continuous. The members of the above firm are well known to the trade in general, and the many souvenirs which they at times send out to their friends and customers help to keep up this friendship and acquaintanceship. Their offices at 225 Dearborn street are the favorite meeting places for electrical men, and those from a distance stopping in Chicago for a few days make their headquarters at that address.

CUSHING & MORSE.

It often happens that the water used to put out fires does more damage than the fire itself. To be able to turn off or on the water just as it is needed would remedy this difficulty considerably. A system of communication has been devised for transmitting signals from the hosemen at the nozzle to the engineer. Two insulated wires are woven into the hose, and their terminals so arranged that when two lengths of hose are joined the proper connections are made. A push button and bell with a dry battery, complete the apparatus. At tests made with hose so constructed signals were sent, and the water turned on or off as the hoseman directed.

The Siemens & Halske Electric Company of America.

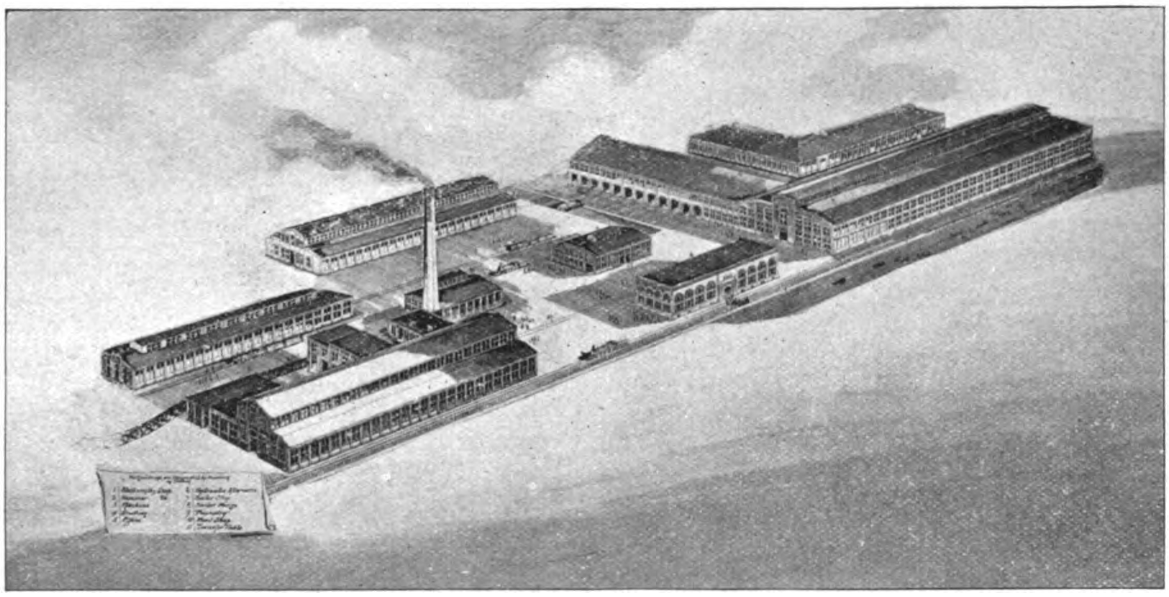
Workmen of the Siemens & Halske company have been busy the past two weeks cleaning up and putting in shape for occupancy the immense plant of the Grant Locomotive works. This plant is located in the town of Cicero, about six miles from the center of the city of Chicago, on Robinson avenue and west 12th street. It is reached by the Wisconsin Central and Chicago & Northern Pacific railroads, and has connections with other lines running out of Chicago. The location, it will at once be seen, is advantageous in more than one respect. The Grant Locomotive Works went into the hands of receivers June 6, 1893, and since that time the plant has been idle. The Siemens & Halske company made a lease on very favorable terms with the receivers, with the consent of the court, and took immediate possession.

Twelve days had not elapsed after the fire occurred that destroyed the company's factory, before arrangements had been made for continuing the manufacture of the electrical machines, which are now well known in America. The pluck and enterprise of the management of the company is here well illustrated. Fortunately, the vaults and safes containing the plans and valuable papers, and also the pattern house with its contents escaped destruction, and the company has been enabled to proceed at once with the manufacture of new apparatus. At the time of the fire the works contained a large number of machines, including the large generators for the power house of the Toronto Street Railway Company, which were nearly ready for shipment. The company had also just received the contract for the electrical equipment of the West Chicago street railway, and a large number of smaller contracts.

Shipments will not be greatly delayed. The confidence of the trade in the ability of the company is shown by the number of important orders that have been taken since the burning of the factory. The works now occupied by the Siemens & Halske company are located on a tract of 80 acres of ground, of which 30 acres are covered by the buildings, leaving the balance for yards. The lands, buildings, machinery and other equipment represent an outlay of $2,000,000. The buildings are of brick, two stories high, well lighted and ventilated. The works contain everything necessary for the manufacture of heavy machinery. By reference to the accompanying cut the location of the various buildings will be noted. The blacksmiths' shop is 252 by 79 feet in size, and contains everything necessary for working heavy metal. The hammer shop is 131 by 71 feet, and contains a full complement of tools, drop and trip hammers capable of forging the largest pieces of machinery. The machine shop contains a 20-ton electric traveling crane that runs the length of the building, which is 342 by 109 feet. It is equipped with the latest modern machinery.

The erecting shop is 300 by 82 feet, and has a 40 ton electric traveling crane. The boiler shop is 242 by 120 feet, contains the latest tools capable of bending and riveting steel from one-quarter to one and three-quarters inches thick, two hydraulic riveting machines of 12 tons capacity, capable of handling two inch rivets, one and three-quarters inches thick. The main foundry is 264 by 80 feet, while brass foundry is 40 by 60 feet with additions. It is skillfully arranged for the rapid production of the best castings. The electric crane will lift 40,000 pounds.

This magnificent plant has been leased at an annual rental of $12,000, and affords unexcelled facilities for the manufacture of machinery. The demand for large generators for electric power stations has greatly increased during the past few years, and no company will have better facilities for their manufacture than the above company. Within a few days there will be a thousand men employed, and more will be added. Branch offices in nearly all of the large cities of the United States place this company in direct communication with customers in every part of the country.



THE SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA.

The Knapp Electrical Works, 271 and 273 Franklin street, Chicago, was closed by the sheriff on August 27th, on a judgment for $29,834 in favor of Frederick M. Knapp. The company occupied the building at the above address, where it manufactured specialties and handled supplies. A statement of the affairs of the company has not as yet been given out. The above judgment was given on a note executed in September, 1893, payable on demand.

Aladdin, jr., which has been the attraction of the season at the Chicago Opera House, is to continue. New features, new songs, new scenes and lighting effects such as have made the extravaganza most interesting and amusing during the summer are to be added, and the spectacle as now presented is fresh and new. Those now returning from their vacations will have a chance to see this extravaganza.

New Apparatus of the Mather Electric Company.

The Mather Electric Company, of Manchester, Conn., has placed before the trade this year a number of new types of electrical machines, including both generators and motors. Two of these designs as shown in the accompanying illustrations, exhibit skill and genius on the part of the originators. Every facility for the economic production of electrical apparatus is possessed by the company at its factories. They are located on the main line of the New York and New England Railroad. The addition of a building, 300 by 50 feet, to be used as an erecting shop, has increased the facilities of the works. A 50 ton electric crane and other machinery and tools for the production of heavy machinery enables the company to produce large generators, both belted and direct connected for railway and power stations. The power used in the various parts of the works is distributed by an electric system of distribution. The use of electric motors has been found economical and satisfactory in every respect.

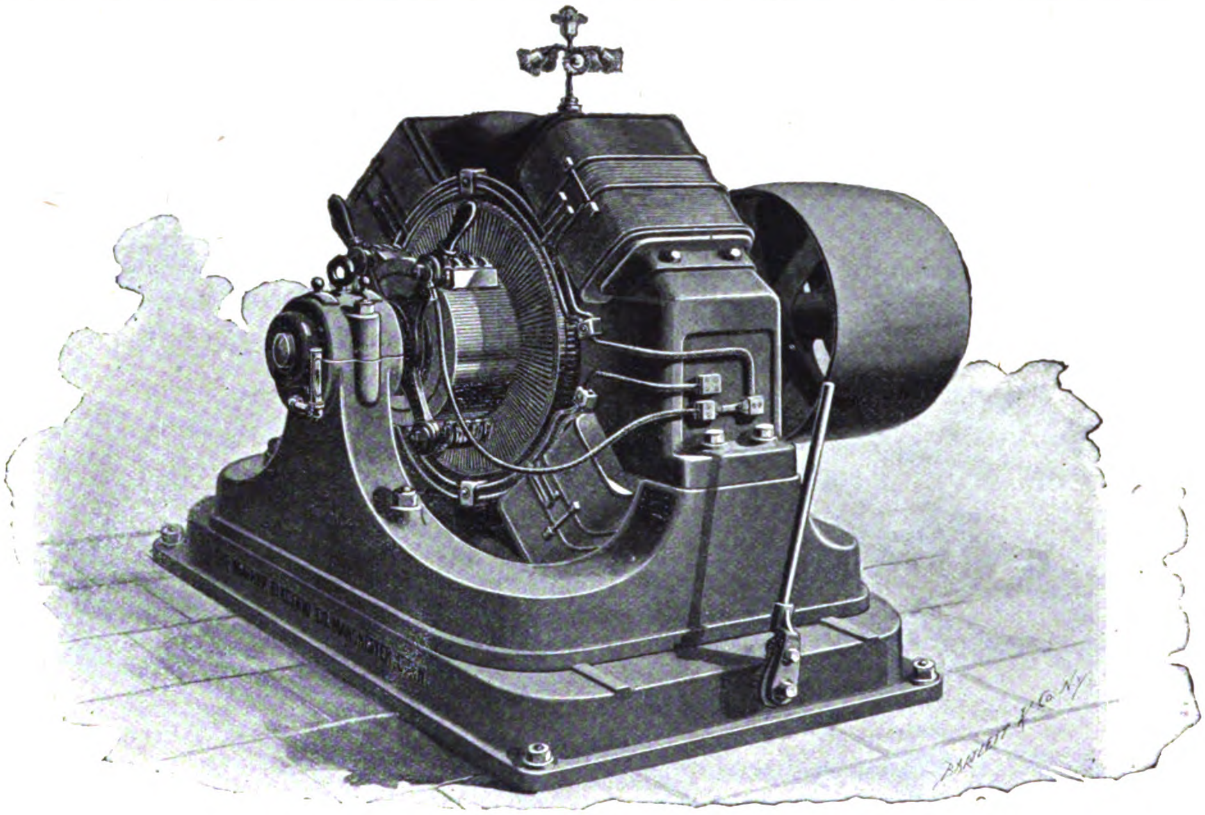


FIG. 1.—NEW APPARATUS OF THE MATHER ELECTRIC COMPANY.

The Mather company was organized as, and has since remained, an independent company. Its experience since it placed its goods on the market has shown that there is a large field for apparatus of this kind. These machines are used both east and west, and increased facilities for their production will enable the company to supply them in larger numbers. The multipolar generator shown in Figs. 1 and 2, of recent design, displays not only the new ideas of design and construction but also those that years of experience have demonstrated to be necessary in an efficient machine. The electrical and mechanical details have been well combined, and it has not been necessary to sacrifice one for the other. The electrical design lends itself readily to the mechanical construction and full advantage has been taken of this fact.

In appearance the machine is all that can be desired. The outlines are well formed and strength is shown without an appearance of bulkiness. The different parts are well proportioned and are joined in a skillful manner. One advantage of this particular type is that on account of the fields being cast in four pieces and entirely separate from the frame, all being bolted together, the assembling or taking apart of the generator to allow the removal of the armature is accomplished in an exceedingly short time and with great ease. These generators are designed to be belt driven or direct connected and, being reversible on their bed plates, can be run in either direction. They are self-regulating, self-exciting, and when started need little attention. The bearings, as will be noted, are large, self-oiling, with sight-feed gauges, and are firmly supported on the frame of the generator. The reservoirs below the journals are large, holding a good supply of oil.

The multipolar generators are compound wound and are equally well adapted for lighting, electric railway or power purposes. The railway generators are wound for 500 volts but can be raised to 600 volts without undue heating. Particular attention has been given to the prevention of sparking at the brushes. This, which is usually caused by the points of commutation shifting with the variations in load, has been so far overcome, that after the brushes have once been adjusted they need no farther attention. In testing these generators, heavy loads are thrown on or off with the brushes in the same position, and from the appearance of the brushes the change in load cannot be detected, there being no sparks. The supports for the bearings and the entire bed plate are cast in one piece, a construction giving strength and rigidity to the entire machine.

The construction of the armature, one of the most important parts of the generator or motor, has received the special attention and skill it requires. The core is built up of thin discs of soft iron forced together and keyed to the shaft. The iron used is made specially for these armature cores. The insulation is as near perfect as possible, the best mica and insulating material being used. Into each slot a mica form is placed before the winding is started. The winding is of a very simple form. At the end of the armature it will be noticed the windings, instead of overlapping, stand out from the core and are separate from each other. The amount of wire on the armature is small, the necessary voltage being secured by revolving a comparatively small number of coils in a powerful magnetic field instead of a large number of coils in a weak field.

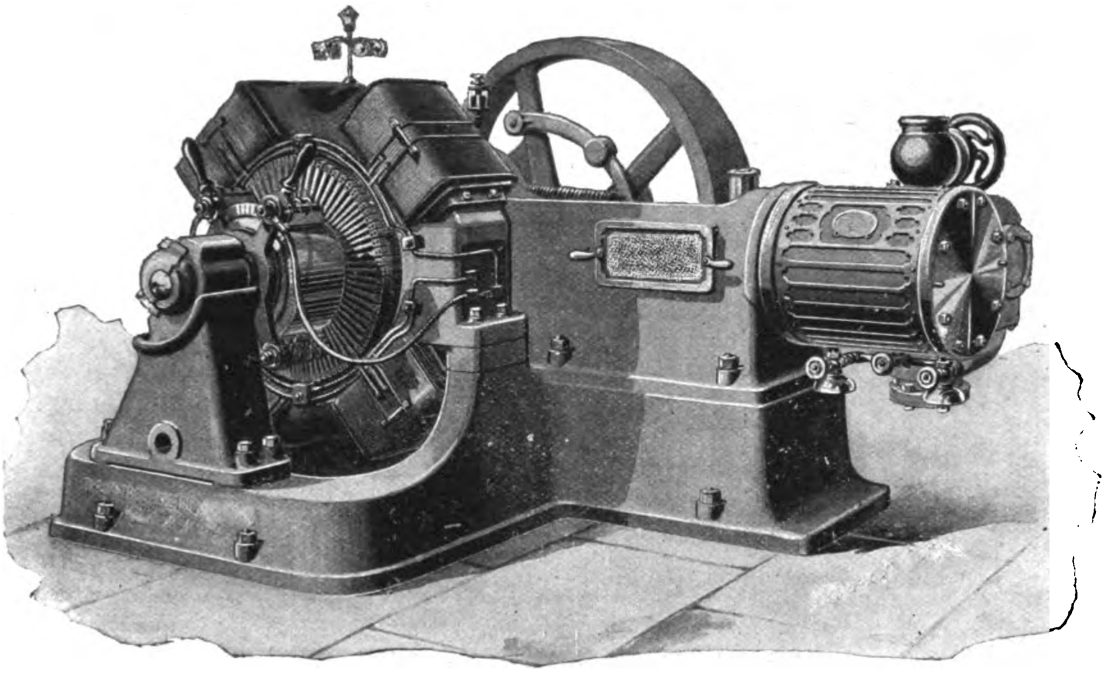
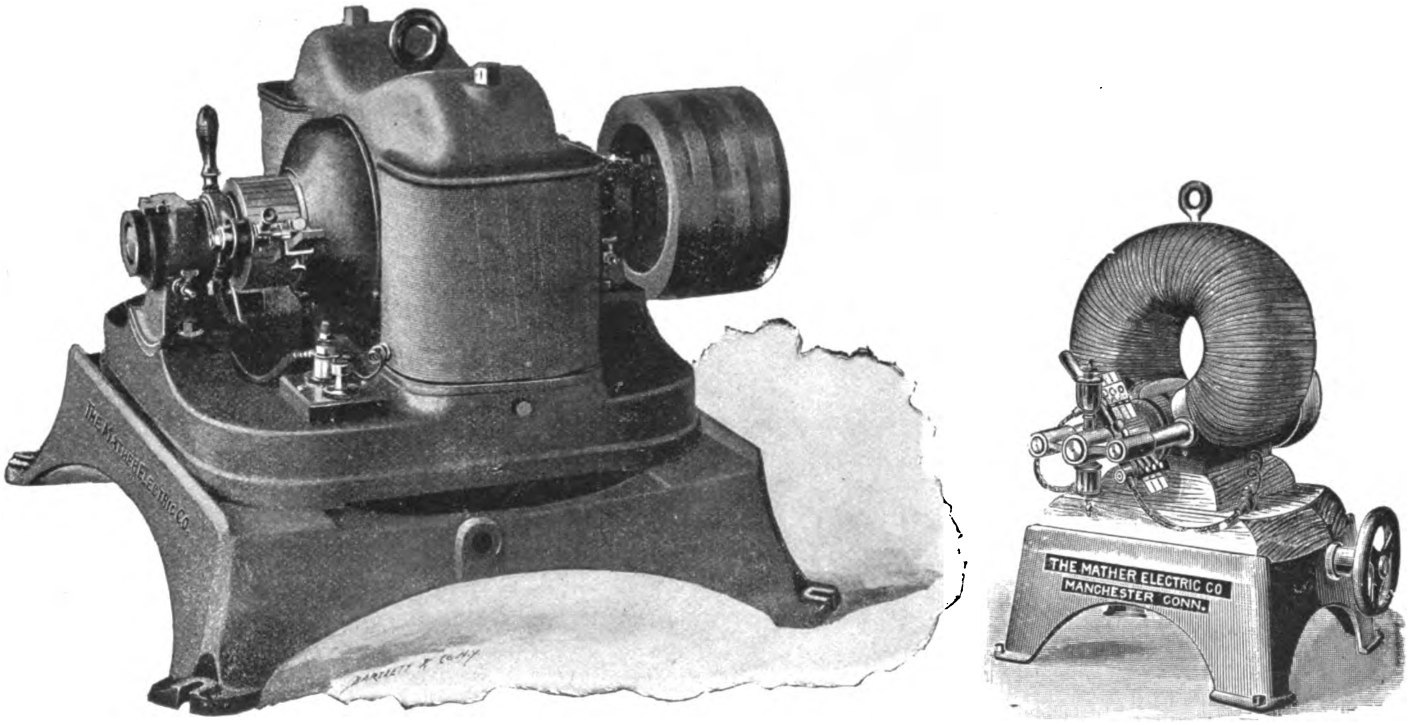


FIG. 2.—NEW APPARATUS OF THE MATHER ELECTRIC COMPANY.

The fields consist of four steel castings, which are rigidly bolted together and which are in turn bolted to the cast-iron frame. The exciting coils are compound wound on metal bobbins that can be slipped off by loosening and raising the field casting. The proportions of the two windings have been carefully worked out so that a close regulation is secured. The commutator is built up of pure lake drop forged copper carefully insulated with mica. In Fig. 2 is shown the Manchester type of slow speed motor. The resemblance to the Manchester motor, which is so well known both here and in Europe, is noticeable. It has few parts, is well proportioned and is slow speed. The fields are of cast-steel and the base and sub-base cast-iron. The same general methods as in the generator has been followed in the construction of the armature. The transmission and distribution of electric power in factories and manufacturing establishments of all kinds has been carefully studied by the engineers of this company. Equipments for plants of this kind are made a specialty of. The advantages of such systems have been clearly demonstrated in the many plants of this kind installed.


THE MATHER ELECTRIC CO.
THE MATHER ELECTRIC CO
MANCHESTER CONN.

FIGS. 3 AND 4.—NEW APPARATUS OF THE MATHER ELECTRIC COMPANY.

The facilities of the company for testing electrical machines is considered one of the best. The steam plant is specially arranged for this work. Before shipping every machine is set up and run under the conditions similar to those it is intended to meet in actual practice. The makers are thus assured of the perfect operation of the generator or motor.

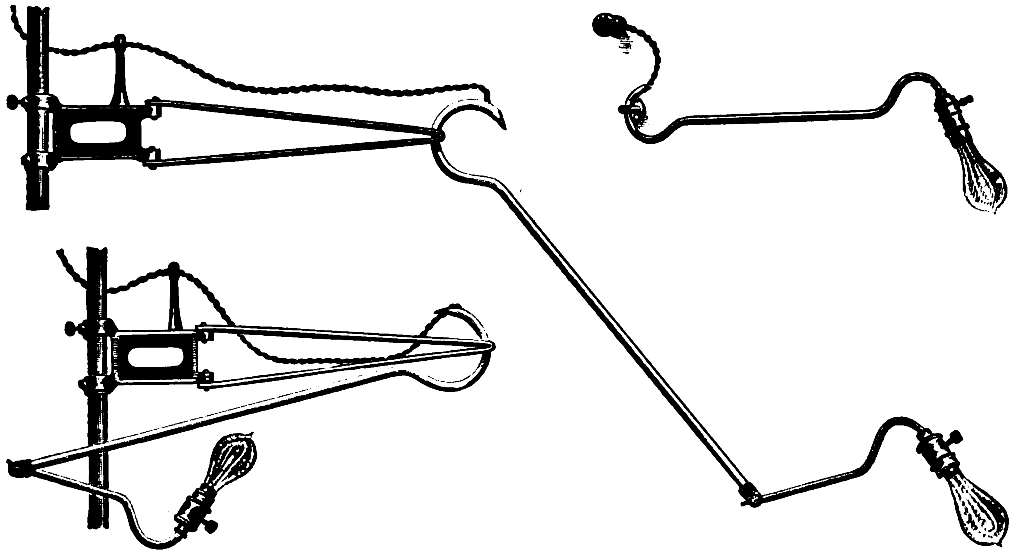
The Mather company furnishes complete station equipments, having facilities for turning out switchboards and station instruments of a high order. Switches, ammeters, voltmeters, lightning arrestors and automatic circuit breakers are made for central stations or power houses. These instruments and appliances are all of standard patterns, which the company has devised and adopted as possessing the most points of excellence.

The factory of the Mather Electric Company is but three hours' ride from either New York or Boston. The sales departments established in both the east and west are in touch with the factory and can assure prompt delivery of all orders. The western representative, Mr. J. Holt Gates, Monadnock Block, Chicago, is well known throughout that territory and can point to many important electrical installations, the equipment of which he has furnished.

Universal Lamp Holder.

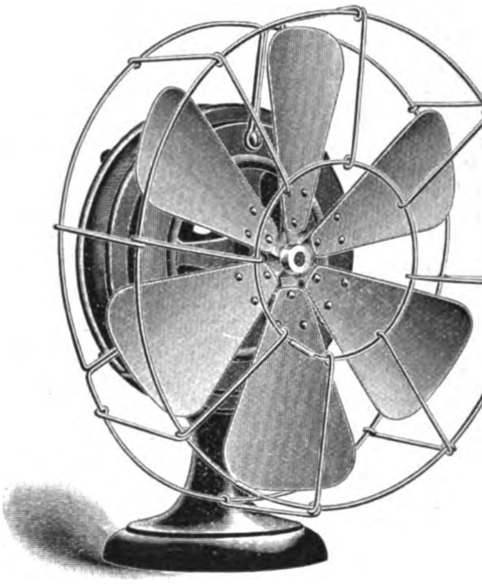
The incandescent light on account of its clearness and steadiness is by far the best light in commercial use where the eyes are constantly employed. For factories and shops where many persons are employed it does not produce a great heat, or take away the oxgyen of the air. Although it is now extensively used in both factories and offices the only drawback has been means of adjusting its position as the work requires. The drop cord fastened back by a string or wire is a favorite method, but is of a temporary character and unsatisfactory.

In the accompanying cuts are shown adjustable lamp holders but just placed before the trade by The Faries Manufacturing Co., of Decatur, Ill. They are not complicated in design; are easily adjusted and are efficient and durable. The different styles shown give a greater or less range. Several methods of fastening to wall or standard are employed and Figs. 2 and 3 may be attached to wall post or standard. Fig. 1 is a single arm holder. The arm, which is 14 inches long, works in a bracket screwed to the wall or post. The curved portion gives the arm a verticle motion and also a horizontal motion in the eye of the bracket. The other figures represent a holder with a greater range of position. It will be found especially useful over a large drawing or work table. The combined length of the arms is five feet, so that the lamp may be placed in any position in a circle ten feet in diameter. When not in use it folds back against the wall, out of the way. The bracket shown is made to attach to pipe or standard, but other brackets are made to attach to wall or post. A serviceable shade is furnished with the brackets, that helps to concentrate the light on the work. Although these adjustable holders have but recently been placed on the market their convenience in factory and office has been shown in the factory of the above company where they have been used two winters.



FIGS. 1, 2 AND 3.—UNIVERSAL LAMP HOLDER.

New Alternating Current Fan Motor.



NEW ALTERNATING CURRENT FAN MOTOR.

The increased use of the alternating systems of lighting has created a large demand for alternating current fan motors. The season now drawing toward a close has witnessed a demand far in excess of previous years. Buildings that are furnished with the alternating current can seldom get the direct current so as to use direct current motors, so that alternating current motors are really a necessity. The motors of this type that have been placed on the market have been a boon to all during the excessive heat of the summer. New inventions and improvements have made these motors highly efficient machines, although of small power.

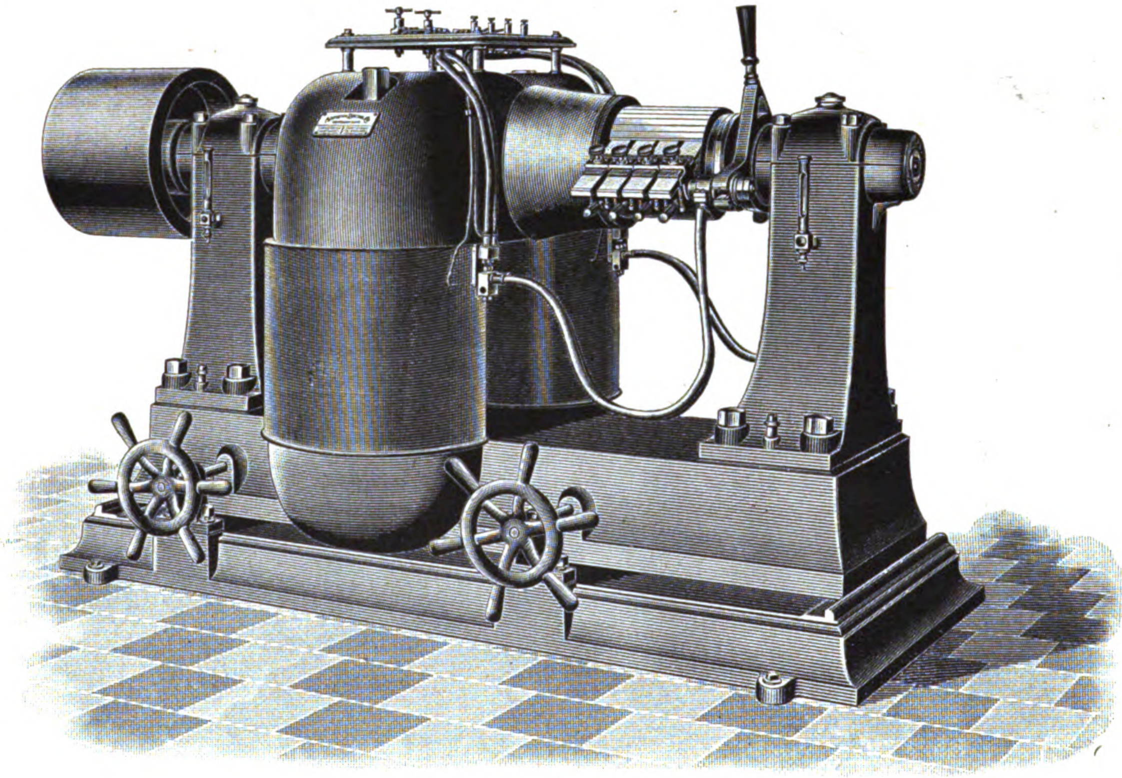
The fan motor of this type that the General Electric Company has placed on the market this summer is remarkable in several respects. The general outlines are shown in the accompanying cut. It has no moving wires, no commutator, brushes or collecting rings. The revolving part is nothing but a mass of iron mounted on a shaft.

The current passes through a number of stationary fields mounted within the frame that surrounds the armature and supports its bearings. They are entirely enclosed and cannot burn out under ordinary usage.

The motor is designed for either 52 or 104-volt circuits. It is small and compact, being but 12 inches high over all, including the fan. The fan is 10 inches in diameter and has six blades. This fan will start as soon as current is thrown on and will revolve 1,800 times per minute, giving a powerful breeze. It is substantially made throughout, with strong frame and base. There is nothing about it to get out of order, and it is therefore a serviceable machine. The fan is protected by a polished brass guard. The motor is neatly finished in black japan.

The National Bi-Polar Dynamo.

The National Electric Company, of Eau Claire, Wis., has placed before the trade a complete line of direct and alternating current apparatus. These lines include a sufficient variety and range of sizes to meet the requirements of almost every customer. The types of machines adopted have been selected with reference to their efficiency and durability. The insulation of the armatures and field coils has been so prepared as to insure a long life. The machines are so constructed as to run as cool as possible, which is conducive to the long life of the dynamo.



THE NATIONAL BI-POLAR DYNAMO.

The accompanying cut shows a type of dynamo which was early adopted at the National factory. The engineers of the National Electric Company have improved the machine in certain details where long service has shown the need. As will be noticed, the design is broad and open, giving a substantial base, while the large open spaces give excellent ventilation. Machines, both motors and dynamos, are built of this type in capacities up to 50 kilowatts. It is strongly built. The heavy base upon which it is mounted is provided with shifting screws so that the belt is easily kept at the right tension. The bearing supports are of ample size and are rigidly attached to the base. The bearings are of the ring self-oiling type and are also self-aligning. The bearing sleeve is provided with a spherical surface which rests in a seat of corresponding form in the pedestal. The bearing, therefore, immediately adjusts itself to the direction of the shaft. The armature shaft is of large size, to secure stiffness as well as strength and is turned from a bar of forged steel.

The armature fits closely between the pole pieces. It is well balanced and is held in its proper place by the action of the fields. Collars are not necessary and some elasticity is given to the shaft, but not sufficient to permit a displacement. The fields are heavy and massive. The cores are wrought iron and the field coils are carefully wound. The armature is of the standard drum type. The core is built up of thin steel discs, insulated and keyed to the shaft. The insulation of the armature has received most careful attention. There are five layers of insulating material between the core and windings. Each winding is insulated and the whole is finely bound together with bands of phosphor-bronze wire soldered together. The armature is thus thoroughly protected from every force that might injure it. The commutator is long and well put together; is made of the best drop forge metal, and gives plenty of room for the brushes.

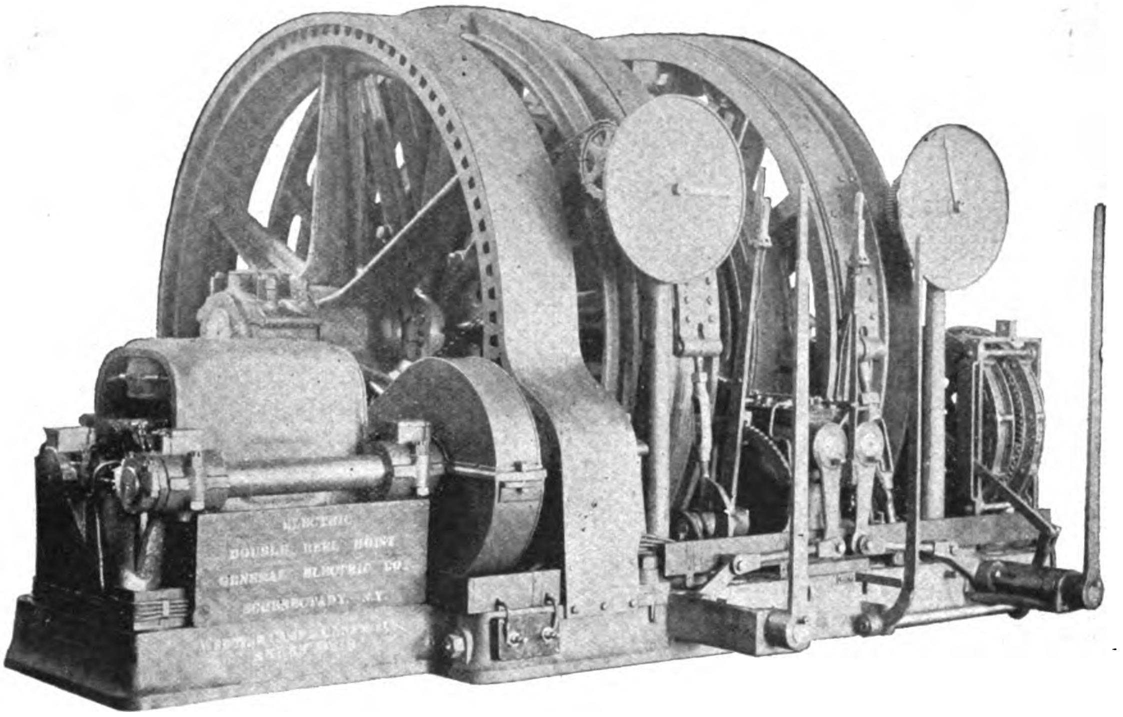
All parts of the machine are made to standard size and are interchangable. Repairs are quickly made. A number of these machines have been installed in both central stations and isolated plants. Messrs. Horne & Martin, of the Old Colony building, sales agents for National apparatus, have found, notwithstanding the quiet season, a good demand for this dynamo.

The street sprinkling cars at Toronto have thus far proved satisfactory to both the Toronto Electric Railway Company and the city. The car is an ordinary truck on which is mounted an iron tank encased in wood. The trolley arm reaches up from the top of the tank. The car runs along at about the speed of the average street car, and gives very good results.

An Electric Mine Hoist.

An interesting installation has recently been made by the General Electric Co. in a silver mine in the south, in which electrical apparatus plays a very important part. The generating plant situated at the mouth of the mine consists of two engines 10½ and 16 by 12. These are connected through friction clutches to a common shaft carrying a band wheel, and each engine operates one D-62 General Electric generator, having 500 volts potential and 85 horse-power output. The power-house also contains a separate 9 by 9 McIntosh and Seymour high-pressure engine operating an arc dynamo of 18 lights capacity and a 150 light incandescent dynamo.

The current is carried from the power-house to the tunnel of the mine and the various shafts over insulated copper wires. At shaft No. 1, 1,000 yards from the mouth of the mine, two hoists have been installed, one of the single drum type, operated by a 16 horse-power motor, the other of the double reel type, a description of which is given below. At a distance of about a quarter of a mile from the station is shaft No. 3 which is equipped with a 25 horse-power single drum hoist. Shaft No. 1 still retains its steam hoist and is provided with a direct connected plant of the marine type.



AN ELECTRIC MINE HOIST.

The large electric double reel flat rope hoist, is probably the largest ever made. It nominally works in balance and has a capacity on each side of 5,000 pounds, the mean speed of the rope being 500 feet per minute. The motive power is furnished by a General Electric 125 horse-power motor of the L. W. P., 20 type similar in size to the large ones used to propel the cars on the Intramural railway. The lower frame of their motor is provided with feet, which allow it to be bolted to the bed plate of the hoist. The maximum demand on the motor will be about 80 horse-power when the hoist is working singly. Under normal conditions, that is, when it is hoisting in balance, the demand will be about 50 horse-power.

The hoist itself is extremely compact, the dimensions of the base, exclusive of the motor, are about nine and one-quarter feet square, the width being increased by about three feet four inches by the addition of the motor. The height is about seven and one-quarter feet above the foundations, the reels, however, extending a little below the level of the bed plate. The reel centers are four feet apart, and have a capacity each of one thousand feet of flat rope three and one-eighth inches by three and one-half inches. The diameter of the naked reel is three feet; this when wound with the rope is increased to eight feet. On account of the direct relation between the working diameter of the reel and the weight of the rope unwound which forms a considerable part of the load, the work done by the motor remains practically constant.

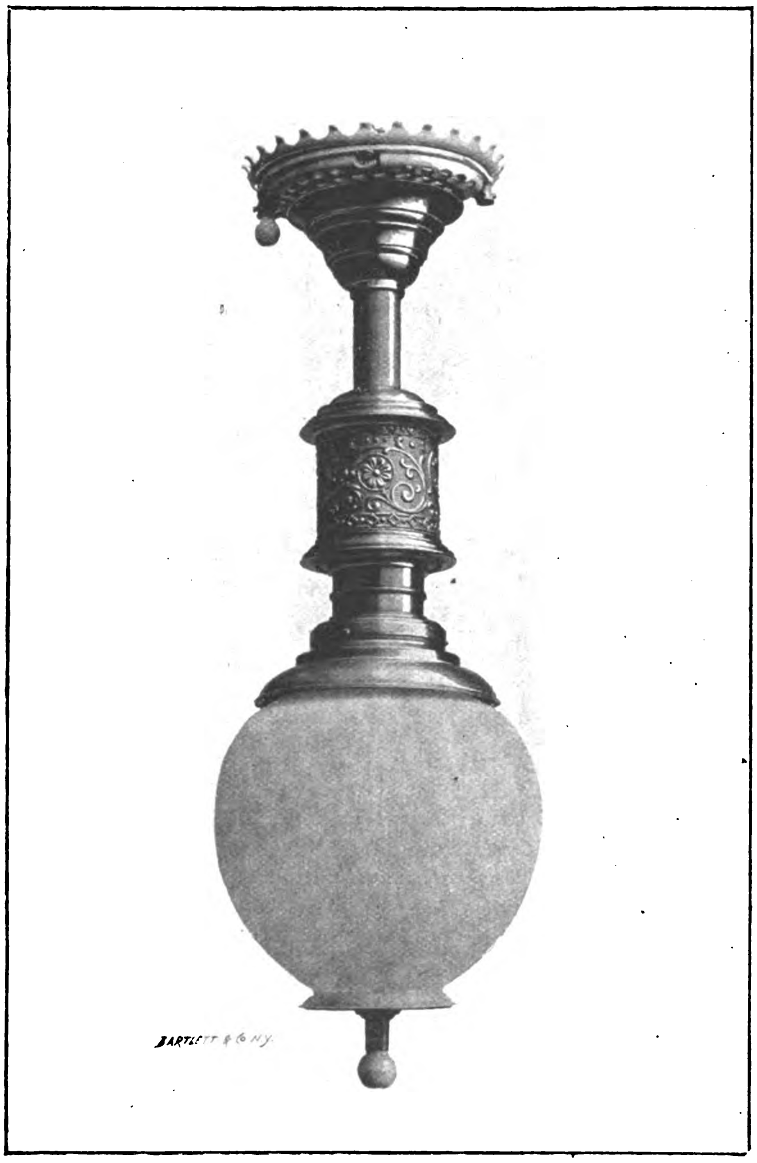
When the load is started from the bottom of the mine the weight of the rope, about 2,500 pounds, is added, but it is being wound on an 18 inch radius. When the load nears the top, only the ore and the skip are being lifted and the winding radius has increased to 48 inches. The average speed of the immediate shaft is 200 revolutions per minute, which gives a starting speed to the rope at the bottom of the mine of 400 feet per minute and at the top 600 feet.

The entire weight lifted from the bottom is about 5,500 pounds, 2,000 pounds of ore, 1,000 pounds of skip, and 2,500 pounds of rope. The reels are loose on the shaft, the hubs having brass bushings which may be readily renewed when worn. To each reel is cast on the side a polished clutch ring five feet in diameter, and upon this is fitted a Webster Camp & Lane band friction clutch, the ring keyed upon the shaft.

It was recently reported that a company had been incorporated for the sale of merchandise on the surface cars of the city of New York. The front platforms will be utilized. Newspapers, confectionery and fruit will be carried. Passengers can secure the latest editions of the daily papers. At certain points depots will be established where the papers will be changed. It is also said the company will also do a shopping business for the patrons of the street car lines. Contracts have been made with the Metropolitan Street Railway Company, and operations will begin immediately on the lines of this company.

The Manhattan Incandescent Arc Lamp.

The accompanying illustration shows a type of arc lamp manufactured by the Manhattan General Construction Company of 50 Broadway, New York. The lamp is termed an incandescent arc lamp, the carbons being inclosed in air-tight globes. The outer globe is air tight at all points except at the bottom, where there is a hand-hole large enough to permit of cleaning and trimming the lamp. This hand-hole is closed by a detachable dustpan. The upper opening of the outer globe is secured to the carbon frame and made air tight by asbestos gaskets, the globe and frame screwing into the body of the lamp.



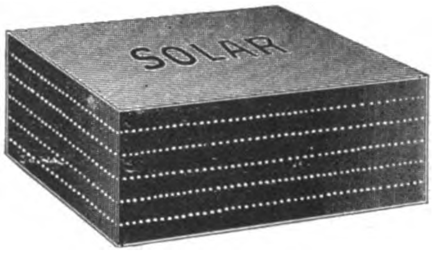
THE MANHATTAN INCANDESCENT ARC LAMP.

Within this inclosing globe and immediately surrounding the arc is a smaller globe into which the carbons are fed, there being, however, no air-tight bearings. On starting the lamp the oxygen in the smaller globe is soon exhausted, and the gas escaping from this globe soon fills the outer globe. The carbons are thus surrounded by gases that prevent further combustion. The life of the carbons, as it will be seen, is greatly prolonged by this method. It is said that carbons will last ten times as long in these lamps. The carbons will then feed but one-tenth as often.

The attachments to be used with these lamps are ingeniously arranged. For inside lamps a rheostat of enameled iron is provided in the shape of a headboard with binding posts, hanging straps and switch. When this method of suspension is not desirable, the lamp may be suspended from a ring.

Wire Gauze Carbon Brush.

The advantages of a brush constructed of a combination of copper wire gauze and carbon, as illustrated in the accompanying cut, will be at once apparent to the reader. The carbon and metal alternate, thus affording a perfect contact. The combined conductivity of copper and lubrication of carbon and graphite prevent the excessive heating of the brush, and thus keeping the commutator cool. The resistance from commutator to line is reduced, and a longer life is given to the commutator, which is kept bright and clean.



WIRE GAUZE CARBON BRUSH.

These brushes are manufactured by the Solar Carbon & Manufacturing Company, of Pittsburg, Pa. This company has recently put a new cored carbon on the market which is said to be superior in efficiency and life. The products of this company are well known among electrical business men.

A New Incandescent Lamp.

A new incandescent lamp has been placed on the market by the Livgro Incandescent Lamp Company, of Harrison, N. J. The president of this new company is Mr. J. Livingston; the secretary and treasurer, Mr. Albert H. Gross and the superintendent, Mr. C. F. Whitemore, who was formerly the treasurer and superintendent of the Davis Lamp Company, of Springfield, Mass.

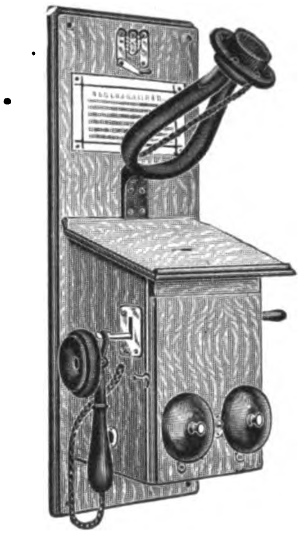
The lamp looks when completed quite like the Edison lamp but differs widely in construction and methods of manufacture. The lamps might be called stopper lamps and yet they are not exactly stopper lamps. The globe is blown with a large neck through which the filament is passed. A mica disc is slipped in the neck of the globe and molten metal, whose co-efficient of expansion is almost identical with that of glass is poured into the neck above the mica disc. The globe is thus sealed with a metal stopper. Above this is placed a re-enforcement of cement, giving the lamp a double seal. It is said that these lamps can be made very cheaply, no skilled labor being required in putting the parts together.

Buffalo is to get 20,000 horse-power from the Niagara Falls electric power plant by October next, according to a reported interview with Mr. Frank W. Hawley, vice-president of the Cataract General Electric Company. When this line is completed there is to be a public demonstration in keeping with the importance of the event. Circuits are to be run to the different cities in western New York, and it is expected that Rochester will be reached by the middle of April.

The Gilliland Telephone Company.

The many telephones that have been placed on the market since the expiration of the Bell fundamental patents exhibit a great variety of forms. Some resemble the old and familiar form of the Bell instrument; some are roughly put together with but one idea, and that to place on the market a telephone at a cost that will give the makers a proportionately large profit, while others show neat designs, easy operation and durability. A glance at the accompanying cut will at once show to what class the Gilliland telephone company's telephone belongs. Its compact form, simplicity and skillful arrangement of the different parts which permits the operator to assume a comfortable attitude while using it are some of the qualities that are at once apparent to the observer.

This telephone set is adapted for any of the services for which a telephone is used, operating as well for an exchange as a private line. For hotels, factories, offices, apartment houses or stores, it can be more easily installed than the simplest speaking tube system and will give a service that is not to be compared with the latter. The telephone instrument consists of a magneto call bell desk for making notes and back board; a bipolar magneto transmitter, placed in a most convenient position to catch the sound of the voice and a hand receiver and cord. The handle of the receiver, it will be noticed, is of a special form that does not require the arm to be raised to an uncomfortable height, but allows a comfortable position to be maintained while using the instrument. It is substantially put together and has been found in service most efficient and reliable.

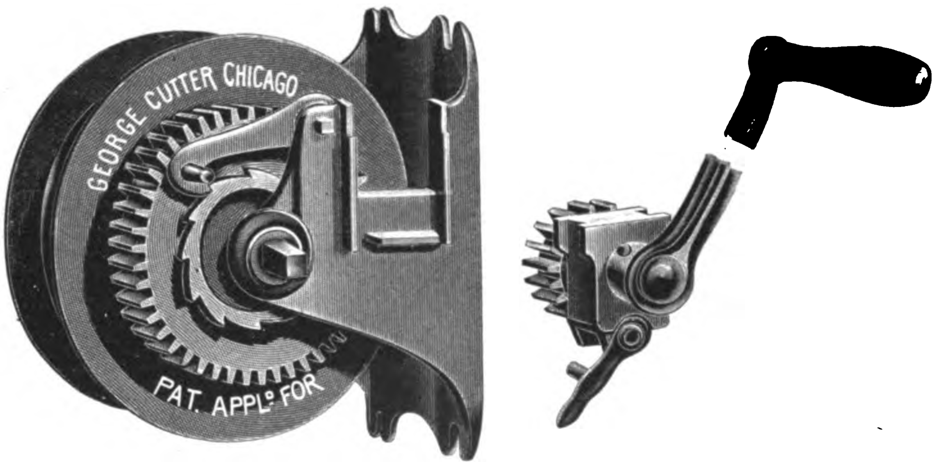

THE GILLILAND TELEPHONE COMPANY.

The officers of the company are well-known in electrical and other fields. The president of the company is Mr. Wm. H. McKinlock, the vice-president, Mr. C. K. Wooster and the secretary, Mr. F. R. Babcock. The general manager of the company, Mr. J. J. Nate, has had a long experience in telephone work and thoroughly understands telephone construction and operation. His ability as a telephone expert and business manager have been valuable in the perfection of this telephone and its presentation to the public. The company has a well equipped factory at Adrian, Mich., where these instruments are manufactured in connection with a large number of other electrical specialities and supplies. The experienced men in the employ of the company enable it to install exchange systems or do telephone work of any kind. The main offices of the company are at 186 and 188 Fifth Avenue, Chicago.

Cutter's Combination Windlass.

The geared windlasses familiar to arc lamp users have two disadvantages. One is the high cost, due largely to the fitting of the pinion and gear; the other is the loss of time in lowering lamps, as the gearing is generally needed only for the raising. These points have been borne in mind by the well known specialty designer, Mr. George Cutter, in bringing out the new form of windlass shown in the illustration. This is called a combination windlass because it can be used either as a plain or as a geared device, at the trimmer's discretion.

The windlass proper has a strong frame with the back curved to fit the pole, the slots for the supporting bolts being so planned that the device can be quickly put up. The handle shown in the cut is rigidly secured to a small pinion mounted in a light bearing which is so shaped as to fit into a recess in the windlass frame. By slipping this into place and locking it with the hinged cam, the pinion is brought into gear with the hoisting drum, thus giving three times the ordinary leverage. The pinion handle with these fittings is still quite light, so as to be easily carried by the trimmer, and as only one of these is needed for several dozen windlasses, there is quite a saving over the cost of windlasses with fixed gears. Of course the details are carefully worked out and the whole looks like a very practical device.

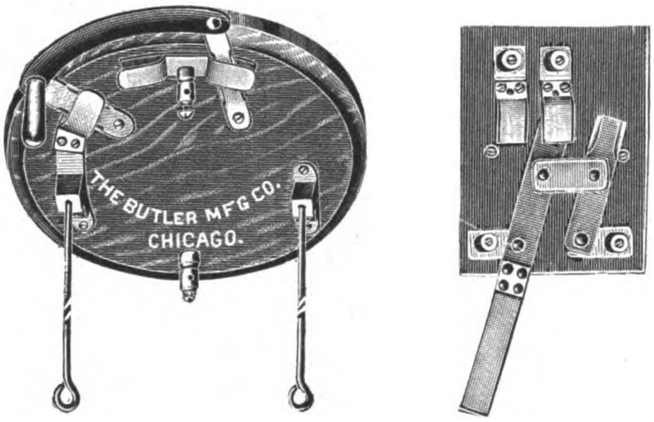


CUTTER'S COMBINATION WINDLASS.

For two months the work of disinfecting the immense amount of garbage that has been dumped upon and around Riker's Island from New York City, has been carried on under the direction of Mr. Albert E. Woolf. The process employed is similar to that used at Brewster, N. Y., where it has been most efficient. The garbage is saturated with electrozone, which is obtained by the electrolytic treatment of sea water. The plant in use at Riker's Island is installed on a barge, which is moored at convenient points about the island. It consists of the necessary boilers, engines and dynamos for generating electricity with tanks, pumps, etc. The sea water is pumped into large tanks, from which it runs into the vat where the electrodes are placed. A current of several hundred amperes at four or five volts transforms the chlorides and bromides of the sea water into hypochlorites and hypobromites, and the solution that passes from the electrolytic vat is ready immediately for use. The supply of water is regulated according to the current generated.

The Specialties of the Butler Mfg. Co.

Among the manufacturers of electrical and street railway specialties of Chicago, the Butler Manufacturing Company of 46 S. Clinton St., has made for itself a position. The company was established some two and one half years ago, and has since supplied a large number of prominent railways and electrical houses with its specialties. Mr. Butler, who is president of the company, was for eleven years connected with the Adams & Westlake Company, where he gained a thorough knowledge of construction work which has been valuable in the manufacture of these goods. An extensive line of street car lighting goods are manufactured, and among the regular customers for this line of goods might be mentioned the North & West Chicago Street railways.



FIGS. NO. 1 AND 2.—SPECIALTIES OF THE BUTLER MANUFACTURING COMPANY.

The new catalogue just issued shows by its numerous cuts the great variety of specialties manufactured and in the accompanying illustrations are shown some of the electric lighting apparatus. In figs. 1 and 2 are shown a hanger board and cut-out for arc lights. The bases are made of seasoned oak, paraffined. The cut-outs are made in one, two or three point styles, and are well insulated in every respect, Hard rubber is used as an insulator; the contacts are made of rolled brass and phosphor bronze, the binding posts and screws are brass, and every part is made strong and durable. In fig. 3 is shown an outrigger for suspending arc lamps from the side of the building. The lamp can be lowered for trimming or raised as may be desired. The hood shown is but one of many styles manufactured. It is made of heavy galvanized iron, japanned on the outside and white enamel on the inside, thus while protecting the lamp from the weather it throws the light where it is most needed. The frame of the outrigger is made of wrought iron pipe with cast connections. It is made in a rigid form when it is not desired to lower or raise the lamp. The company also manufacturers an extensive line of guards, spark arresters, etc., for arc lamps.

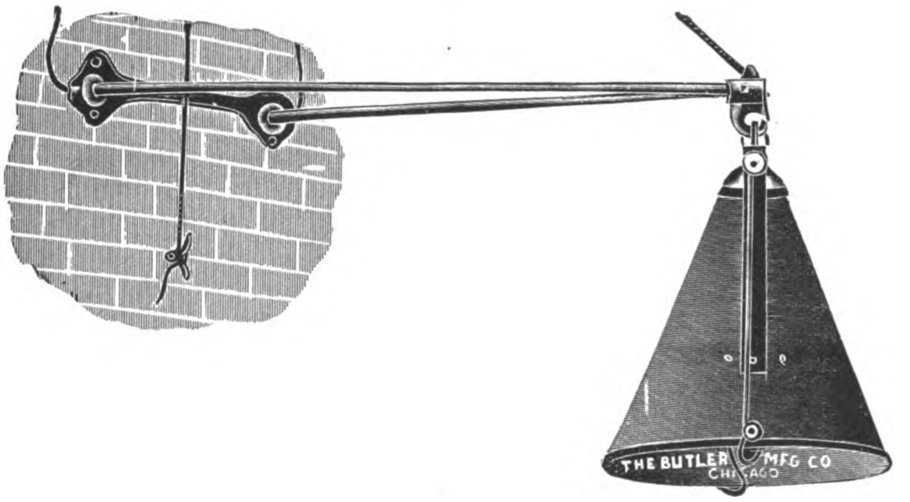


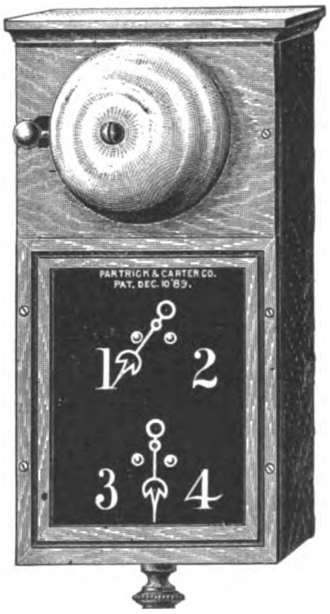
FIG. 3.—SPECIALTIES OF THE BUTLER MANUFACTURING COMPANY.

An Electric Life Buoy.

A new application of the incandescent lamp has been made by a German company. The lamp is to be used as a signal on a life buoy to mark its location on the water. The buoy is covered with canvas and is capable of supporting three persons. Within the buoy is a double wooden box containing an accumulator with gelatine material. The accumulator will furnish sufficient current to feed the lamp, which is supported on a frame above the buoy, for six hours. The accumulator will remain active for two months, when it has to be recharged. The electric circuit is automatically completed when the buoy strikes the water. The lower part of the covering being raised by the water releases the springs that close the circuit. When hanging on the ship's side the weight of the lower portion automatically opens the circuit.

The New King Annunciator.

The King annunciator has been extensively used, and has been found very satisfactory, In the accompanying illustration is shown the new form of the annunciator manufactured by the same company, the Partrick & Carter Company, of 125 S. Second street, Philadelphia, which is a modification of the older form. It is of durable construction and finished in oak and walnut cases. It is made in four sizes, two, four, six and eight call, which are numbered or lettered as may be desired. The bell is movable, so that the working parts can be readily examined without taking down the case. The annunciator is easily wired and is not liable to get out of order. The design is neat and substantial, and is well adapted for resident use. The facilities of the manufacturers enables them to be placed on the market at a reasonable figure.



NEW KING ANNUNCIATOR.

Progress in Gas Motors for Street Railways.

In the consular reports for the present month Consul-General Frank H. Mason has an article on the above subject. Recent experiments in England by the owners of the Lührig patents, he says, during the past four or five months, have modified the car so that, from trustworthy accounts, its weight and cost have been lessened and its practical value enhanced. A car of this improved type is now worked regularly on the lines of a tramway company at Croydon, near London, and has attracted expert attention from all parts of Great Britain, where the problem of street railway equipment and management is quite as complicated and difficult as in any portion of the United States.

Not less than $70,000,000 is invested in tramway lines in the United Kingdom, with results so generally unsatisfactory, as regards profits to stockholders, that there is a wide and urgent demand for a new and simplified motor or system that will secure equal effectiveness and greater economy in operation. Notwithstanding the relatively dense population of Great Britain, only a small proportion of its tramways as worked at present by cables, steam locomotives, electricity or horse-power, are really satisfactory to the public or pay regular dividends. The same need exists there, as elsewhere, for a motor which shall be clean, noiseless, manageable, independent of overhead or underground constructions, and withal, so cheap in initial investment and working expense as to successfully supersede horse cars, to which there are many objections on the score of cleanliness, speed, and economy on lines which have a light or varying volume of traffic.

One important difficulty in the case of every self-contained car lies in the fact that, for climbing grades, starting under full load, passing curves or meeting sudden falls of snow, a car which, when in motion, can be easily drawn by two horses must be equipped with a motor capable of exerting temporarily 10 or 12 horse-power, and for this a considerable weight of machinery is unavoidable. The general defect which has been found in gas motors for street-railway purposes hitherto has been that they have been available only for light traffic, and, if made sufficiently powerful for city lines, their excessive weight and cost would form a fatal objection.

Through the modifications which have been made in the Lührig motor car by the English engineers, these defects are believed to have been practically overcome. The original car was rigged with two double-cylindered gas engines, one under each seat, and both working upon the same driving shaft, and weighed, without passengers, 7½ tons. In the improved car but one gas engine is used, the two cylinders of which are set facing each other, and both working to the same crank. The engine is located under the seat on one side of the car; the other end of the driving shaft, which extends across beneath the floor of the vehicle, carrying a fly wheel, which steadies and regulates the motion of the engine. By this improvement, the number of working parts, and, therefore, the weight, cost and wear and tear of the motor have been greatly reduced. What is equally important, in a commercial sense, the motor has been reduced to a form and dimensions which will permit it to be adjusted to cars already built for cable, electricity or horse power.

But, by reducing the engines to one, the power of the car to start promptly with a heavy load was compromised. and this weakness has been overcome by the momentum of the fly wheel, and by the device of keeping the engine constantly in motion while the car is in service and transmitting its power from the crank shaft, through a second-motion shaft, to the running gear, by friction clutches under the control of the driver. This is arranged as follows:

The driver, standing on the front platform, has before him the brake wheel, and beside him a movable lever, not unlike the reversing bar of a locomotive. When this lever is in a vertical position, the engine shaft is disconnected from the second-motion shaft and the axles, so that the car may be at rest while the engine is running free. When the lever is pushed to the right, the second-motion shaft, with which the axles are connected by chain gearing, is brought into engagement by a pinion and friction clutch, which gives the car a speed of 4 miles per hour. Shoving the lever to the left brings into similar engagement a larger pinion, which, without changing the speed of the engine, gives the car a pace of 8 miles an hour, which is the limit allowed by the municipality of Croydon. A second lever is provided for operating reversing clutches whenever, at the end of the line or elsewhere, the movement of the car has to be reversed. The friction clutches, which form so important a feature of the machine, are made of hard wood set between the two discs of iron, and are said to be effective and durable.

There must be, of course, some device to regulate the speed of the engine and keep it as nearly as possible uniform while the car is stopped and under the varying conditions of grade and load. This has been provided for with great ingenuity--first, by a governor, which, when the work is light, cuts off automatically the gas supply from one of the cylinders, leaving the other to do the work alone, and, still further, through a mechanical connection between the governor itself and the lever, already described, which operates the clutches. When this lever is upright and the engine shaft disengaged from the axle gearing, a weight on the spindle of the governor is lifted which cuts off the gas at half stroke in the one working cylinder, so that, while the engine is running free with the car at rest, it is reduced to half speed, and the explosions are rendered so light and gentle as to be hardly perceptible.

Ordinary street gas is used, condensed to a pressure of 10 atmospheres, and the reservoirs under the floor of the car, which can be filled through a flexible pipe within the time repuired to change horses, carry gas enough for a run of 8 or 10 miles. The consumption of gas by a loaded car is stated to be 25 cubic feet per mile, which costs, at Croydon, 2 cents.

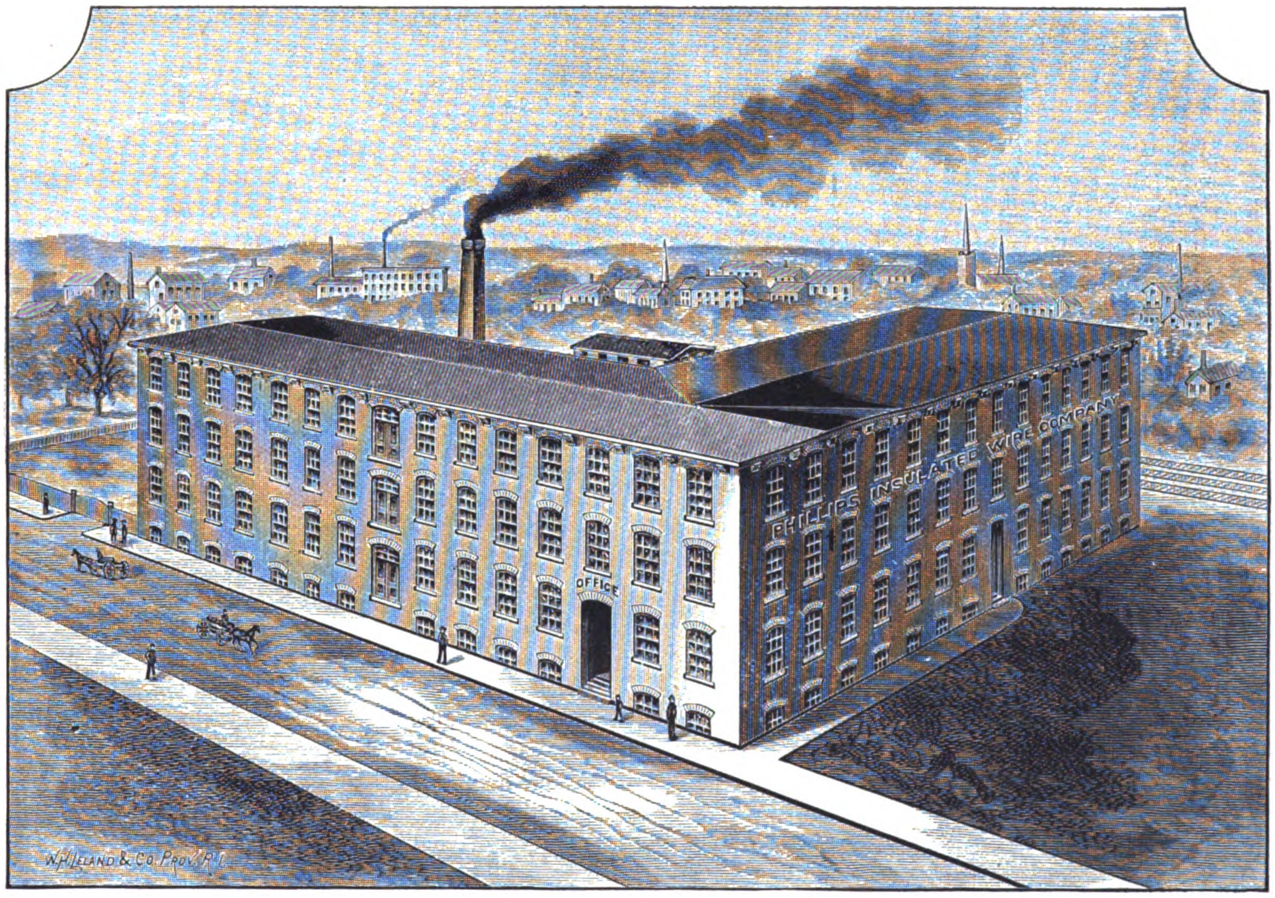
A special motor car of the type above described, combining all the improvements thus far made and reduced to the utmost limit of simplicity and lightness, is now being constructed in England, to be carried to the United States for exhibition and trial in October. Its performances will doubtless merit the attention of all who are interested in the complicated subject of city and suburban transportation.

The largest central station in the United States will be that of the United Electric Light & Power Co., of New York, now under construction. The power house is planned for an aggregate capacity of 20,000 horse-power. The Westinghouse company will furnish for this station eight of the large 15,000-light dynamos used at the World's Fair. As soon as the roof of the new power house is on the work of installing the electric apparatus will commence.

New Factory of the Phillips Insulated Wire Company.

The new factory of the Phillips Insulated Wire Company has now been running four months, and everything is working smoothly. The company during the years they have been in business, have always been cramped for proper accomodations and finally decided to erect a factory which should suit their needs instead of being compelled to have their business suit their surroundings as has been the case for so long a term of years.

They accordingly erected a building at Darlington, a suburb of Pawtucket, R. I., where superior freight facilities could be enjoyed, a spur track from the East Providence branch of the N. Y., N. H. & H. R. R., running to the shipping department. The building is built of brick, with granite trimmings, is 186 by 50 feet, three stories and a basement, giving a floor area of 36,000 square feet, all of which is devoted to the manufacture of their specialities.


OFFICE
PHILLIPS INSULATED WIRE COMPANY
W. H. LELAND & CO. PROV. R. I.

NEW FACTORY OF THE PHILLIPS INSULATED WIRE COMPANY.

The power plant consists of a 100 horse-power tubular boiler from the Bigelow Works, New Haven, and a 60 horse-power Green engine built by the providence Steam Engine Company, located in a separate building but in close contact with the main building. Sufficient space is here reserved for another tubular boiler, as well as for a smaller engine and motor for generating electricity for lighting the building. Especial attention has been paid to rendering the building as safe from fire as possible, the whole building being equipped with the Newton Automatic Fire Extinguisher, while stand pipes and hose are located on each floor.

The steam heating and plumbing has had more than ordinary attention, and taken altogether the plant is a model for convenience and safety.

The offices are on the ground floor, in the northeast corner of the building, and are very light and cheerful, finished in hardwood and handsomely fitted up. The firm are thorough believers in electricity and its many applications, and have exemplified their belief by making use of it in many directions. They are about to install an electric plant capable of generating power for 200 incandescent lights, and it is needless to say that their "Ideal" wire will be used in connection with this installation.

Self-winding clocks are situated at each end of the building on each floor, and are connected electrically with a master clock in the office. A watchman's clock, made by the Eco Magneto Clock Company, of Boston, is located in the office, and connected with stations throughout the factory. Telephones connect the office with the different floors.

The heating of the office is regulated by an electric thermostat made by the Electric Thermostat Company, of Minneapolis, insuring steady temperature. Fans overhead insure plenty of cool breezes this summer. The steam pressure in the boiler is registered in the office on a "Peerless" gauge indicator, and the pressure on the steam circulation for heating the building is also recorded there.

The superintendent's office is cosily located on the lower floor opposite the main office. Everything has been done to make this plant as complete as possible, with the distinct idea of having every department in close touch with the office, and of knowing at any minute just what is occurring at various parts of the building.

For a number of years past their product has been well known, and "O. K. Weatherproof" wire needs no introduction to the electrical fraternity. They have during the past year added a new wire to the list, and already "Ideal" insulated wire has been favorably received, and bids fair to occupy a field by itself for use where a high class of weatherproof is needed, either for line wire or for inside wiring. The new process consists in taking the raw cotton fiber and applying it as a tape to the wire, which process admits of a most thorough saturation by the insulating compound, the particles of cotton becoming matted into one solid envelope about the wire. Repeated tests of immersion have shown surprising results.

"O. K." and "Ideal" wires are finally housed in good quarters and their legion of friends are sure of a welcome whenever they may elect to favor the company with a visit.

The works are connected by long distance telephone and the officers would be pleased at any time, to receive a "Hello" from friends who cannot conveniently favor them with a visit. The New York offices of the company are located at 39 Cortlandt street, Taylor building, and are in charge of Mr. H. C. Adams, president of the company, who looks after its business in that vicinity. The Chicago agent is the Electric Appliance Company, 242 Madison street, Chicago, Ill., who carry at all times a large stock of their wire, sufficient to supply whatever demands may be made upon them.

THE ASSOCIATIONS.

The annual meeting of the Old Time Telegraphers and the U. S. Military Telegraph Corp is to be held at Baltimore, on September 12.

Considerable interest is already manifest in the coming convention of the American Street Railway Association, which meets next month at Atlanta, Ga. As already announced in these columns everything has been arranged for the meeting, accommodations for the exhibits as well as for the sessions of the convention.

The fourth annual meeting of the American Electrotherapeutic Association is to be held in New York on September 25, 26 and 27 at the New York Academy of Medicine. A large number of papers have been prepared on subjects that will be most interesting. The opening address will be made by Prof. W. J. Herdman of Ann Arbor.

ANNUAL MEETING OF EDISON ILLUMINATING COMPANIES.

The Association of Edison Illuminating Companies met at the Hotel Vendome, Boston, on August 14, 15 and 16. The convention was well attended and the lists of subjects discussed were all of importance. Strict attention was given to the business of the meeting and the meeting was considered one of the most successful in the history of the association. The social advantages were not neglected and on Thursday visits were made to the power house of the West End Railroad, the station of the Edison Illuminating Company, the works of the General Electric Company at Lynn, and as guests of the latter company went to Marblehead, where dinner was served and the pleasures of that resort enjoyed.

The first session on Tuesday morning was devoted to the admission of new members, the report of the committee on lightning protection, crosses and grounding of the neutral. Prof. Marks read a paper on a Board of Control and Mr. Hale a paper on Boiler Tests. At the second session papers were read by Mr. Van Vleck, on the New York Company's Switchboard, Mr. Page on Incandescent Lamps, Mr. W. S. Barstow on Low Tension Arc Lighting System, and Mr. Pierce on Methods of Electrical Distribution Used by the Boston Illuminatting Company.

Mr. Lieb on Wednesday morning read a paper on Storage Batteries, and also one on the same subject, by Mr. R. R. Bowker. A committee on storage batteries, consisting of Messrs. Ferguson, Marks, Lieb and Edgar was appointed at this session after the discussion of the above papers. President Coffin, of the General Electric Co., opened the second session with an address. A paper was then read by Mr. Emmet, on the Advantages of the Direct and Alternating Current. After disposing of unfinished business the business meeting adjourned.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Forty-Third meeting of the American Association for the Advancement of Science was held in Brooklyn on August 16 to 22 inclusive. The association, after a general session, divided into sections. The papers read and discussed before Section D—Mechanical Science and Engineering, were as follows: The Crank Curve, by Mr. J. H. Kinealy; Preliminary Experiments on a New Air Pyrometer for Measuring Temperatures as High as the Melting Point of Steel, by Prof. D. S. Jacobus, who also presented a paper on Precautions Necessary in the Use of Mercurial Thermometers in Determining the Amount of Super-Heat in Steam, and a paper on Improvements in Methods of Testing Automatic Fire Sprinkler Heads; Ratio of Expansion of Steam in Multiple Expansion Marine Engines for Maximum Economy in Fast River Steamers, by Prof. J. E. Denton; Experiments on the Transverse Strength of Long Leaf Yellow Pine, by Samuel Marsden, and a paper by Elmo G. Harris, on The Air Lift Pump. · Among the papers read in Section B, Physics was one, by Prof. B. W. Snow, of the University of Wisconsin, on the Direct Velocity of the Particles in the Electric Arc.

Obituary.

Mr. William F. Cullen died at his home in New York on August 9. He had held a prominent position with the E. P. Gleason Manufacturing Company for several years and was well known and esteemed by the electrical trade of New York and vicinity. His connection with the above company dates back twenty years, when he entered its employ as errand boy. His ability and integrity soon won the confidence of his employers and his advancement was rapid. About three months ago a leave of absence was granted him on account of ill health.

Mr. Charles H. Rudd died at the Presbyterian Hospital on August 9 from injuries received on July 31. Mr. Rudd has been connected with the Western Electric Company as an electrical expert and was well known in electrical circles. He was a man of acknowledged ability and had devised a number of important electrical appliances. It was while experimenting with a new high explosive which he had invented, at the stone quarries of Dolese & Shepard, near Hawthorn, that he received the injuries which resulted in his death. The unfortunate accident resulted in the instant death of three men and several persons were seriously injured besides Mr. Rudd. The many friends of Mr. Rudd greatly lament his untimely death.

The patents owned and controlled by the Royal Arc Electric Company, were purchased at receivers' sale by Mr. J. I. Ayers who was the only bidder, for $500.

A BRIEF REVIEW.

ELECTRICITY IN THE COAL PIT

The electric mining plant has ceased to be a nine days' wonder. Its adoption has been marked with the caution and conservatism characteristic of mining men, who are not easily susceptible to innovations and crudities, and who only change methods when satisfied as to their merits. The probationary term being passed, electricity has found its way into every phase of mining practice with astonishing rapidity. It has not, however, yet reached that point of economic efficiency which would warrant its general introduction. That will come along when conditions are more carefully studied and applied, and is a matter simply of time, but not of doubt. It has the merits of safety, reliability and efficiency. In flexibility and simplicity it is ahead of other power agents competing with it in the peculiar and arduous demands of mining service. Steam, compressed air, hydraulic power and wire rope transmission have each their special vocation and merits, and under certain circumstances and conditions will always retain their place. Where, however, the new energy is a demonstrated success in efficiency and economy, other forms of power must eventually make way for the better and the best.

The power used in a mining plant is consumed in drilling, pumping, ventilation, winding, hauling, signaling and explosive firing. In each and all of these several phases of service, electricity has demonstrated its value. The electric diamond drill, equipped with a special motor and electric pump, has been found of special value and utility both in coal and metal mining. In an experimental test made by this instrument, 12 inches of blue granite were bored in three minutes umder 120 pounds water pressure, furnished by the attached electric pump; under 75 pounds pressure it bored 12 inches in six minutes, and with 35 pounds in sixteen minutes. The electric pump, triple, single and double acting, enclosed in water-tight cases, the motor working as well under water as in it, is invaluable where there is a liability to a sudden flood of water. A duplex double-acting pump of this type has a capacity of 100 to 300 gallons per minute. The electric hoist has been installed in all sizes and varieties, one of 7½ horse-power raising 250 tons 250 feet up a 60 degree incline every twenty-four hours. Electric haulage has been so far developed that a locomotive in a Pennsylvania mine delivers 360 tons an hour, hauling 30 cars a distance of 4,000 feet every fifteen minutes. Electric coal cutters have undercut from 125 to 300 lineal feet in ten hours to a depth of six feet.

The electric light in coal mines is of marked benefit. It is strong and steady, is innocent of obnoxious fumes and smoke, can be instantly lighted or extinguished, and is less harmful, it is claimed, to the eyesight of miners. In explosive firing time is gained, and the proportion of missed shots reduced by the use of electricity. In mine signaling the telepone and electric bell has its manifest conveniences and utility.

It will be readily seen that electricity in mines has its special advantages, and will add to these as electrical science is better understood.—Age of Steel.

FIRE ROOM ECONOMY.

The paper read by Mr. John C. McMynn at Chicago brings up a subject that will soon receive more general attention than it has in the past. Heretofore there have been so many other directions in which obvious savings in central and power stations could be made that the fire room has been neglected, but now that dynamo machinery is pratically perfect, and the economy of the steam engine is receiving close attention, the considerable savings that may be made in the boiler department will, in turn, be taken up. It is well, therefore, to examine into the various factors influencing the efficiency of this department in order to see in what directions savings can be made, and the relative amounts. A boiler transforms the chemical energy of coal into the expansive energy of steam, and like in all other transformations of energy, perfect efficiency cannot be attained. To consume the coal air must be used, which at once introduces an element of inefficiency, for almost 90 per cent of the weight of gas admitted passes off in an uncombined state, but with its temperature increased, and the part of the oxygen utilized, as well as the gases from the coal, also carry off heat. The less air admitted, therefore, and the lower its temperature when it passes into the atmosphere, the less heat will pass off. With mechanical stokers the former condition can be approximately attained, and only the exact quantity of air necessary for combustion admitted to the furnace. Through their use, therefore, an undoubted gain may be made, which, however, it seems high to place at 30 per cent unless the hand firing superseded was unusually inefficient. The gain from mechanical stokers not only results from allowing a proper regulation of air, but also from preventing great wastes in opening furnace doors for firing, and in permitting a more efficient combustion of fuel, if accompanied, as we believe they always are, with means for mechanically working the fires. By increasing the ratio of the heating to the grate surface the outgoing gases will be further cooled, but as each square foot of such surface added decreases in heat absorbing power on account of the decrease in the difference of temperature between it and the outgoing gases, a commercial limit is soon reached, beyond which it would not pay to add further surface, and as in practice it is probable that such a limit has been attained, there is not much, if anything, to look for in this direction. The difference of temperature between the ingoing and outgoing gases may be decreased by heating the former, thus introducing a saving, but the reverse will be the case, it should be needless to say, if the steam in the boiler supplies the heat, as seems the condition in the case quoted in the discussion of Mr. McMynn's paper. The gases, after they have passed by the steam surfaces of the boiler, ordinarily can be drawn on for sufficient thermal units to heat both the entering air and feed water, but even here there is a limit with natural draft, for the gases must have a considerable temperature, depending upon the height of the chimney, to furnish the necessary draft head. With blowers, however, we have a different set of conditions, and their use in connection with mechanical stoking, seems to present ideal conditions for efficiency. With blowers the air required can be regulated to a nicety, and for all rates of combustion; being independent of natural draft, the gases, after doing duty in the boiler, may be forced into a second chamber, and by passing over feed water surfaces and finally over thin pipes through which the air for combustion is drawn, their temperature may be reduced below a point possible with natural draft. The pressure at which the blowers should be worked will depend upon the mechanical obstruction offered by the above surfaces, and their useful heat absorbing area, so that without these data it cannot be predicted. For a given case it would be determined by the final temperature of the escaping gases. The only economy in the use of blowers is to reduce this temperature, and as the difference of temperatures between the boiler surface and gases cannot be economically reduced below a certain point it will be seen that feed water or air heating surfaces, or both, are necessary to attain this economy. There are cases, of course, where blowers may be used with economy, though leading to a direct waste of heat, as in stations with a sharp peaked load line where the waste, during the short time daily the blowers are used, may be more than compensated for by less first cost of boilers, less space occupied and less waste during the other hours from radiation, banked fires, etc.; also where a cheap grade of fuel may thereby be substituted for a more expensive one. It is probable that with the combination here outlined a boiler efficiency of probably 80 per cent may be attained. At present 75 per cent is a very high figure for boilers in normal condition, while 50 per cent is perhaps nearer the usual proficiency, so that we have a margin of 50 per cent for savings, though, of course, this will be reduced by the interest on, maintenance of, and cost of working the increased apparatus. We have assumed that condensing engines would be used with the boilers, for otherwise the cost of change to that type would ordinarily offer enough of an economical margin to put off the fire room for future attention. It has also been assumed that such obvious matters as boiler lagging and setting are attended to, for it would seem to be useless to expect an intelligent interest in any question from a man who loses 15 per cent by an inferior boiler setting, though we doubt if such cases are as frequent as Mr. McMynn's remark would seem to apply.—Electrical World.

ELECTROLYTIC CORROSION: LEGAL STATUS OF THE QUESTION.

Water, gas and other companies using conduits and operating throughout the country are industriously taking counsel with a view of obtaining their protective rights against electric railway companies chargeable for the damages alleged by reason of continuous injury occasioned by escaping currents. Water and gas supplies are necessary to the health and comfort of the citizens of a municipality, the latter in some instances owning the plants. Thus, the question becomes one of common interest and demands co-operation for mutual protection. If remedies are reluctantly adopted or are applied with doubtful success, a resort to the courts will unquestionably follow.

The first legal struggle took place between the telephone and electric light companies. The Nebraska Supreme Court interfered so far as to protect telephone wires already set up in a street by compelling the electric light company to keep its conductors at a certain distance, but relief was refused as to those streets which had already been occupied by the electric light wires. But in case of an electric railway it was necessary that the battle be fought to a finish, for the reason that in this case electricity was simply applied to the uses of an interest which had acquired a prior right and occupied the streets long before the telephone was invented; hence its use for purposes of public travel gave it a superior claim to the use of the streets. (A number of legal decisions are here referred to.) It will thus be seen that the question between the telephone and electric railway is still open for argument, and that a conflict of authority exists so far as courts are concerned. But, applying the weight of authority to that of a recent cause decided by the United States Supreme Court and assuming that a water company or a gas company stood in the precise attitude of a telephone company, it would be the rule to compel a street railway company to adopt the double trolley system if that would obviate the injury to the complainants without exposing the railway company or the public to any large expense; but if it could be proved that a more effectual and less expensive remedy is open to the complaining water and and gas companies, the latter's duty would be to adopt such a remedy, and a failure to do so would relieve the railway company for any liability to indemnify. (See 42 Fed. Rep., 273.)

By a careful review of a recent Ohio Supreme Court decision it is safe to assume that public travel is the chief purpose for which streets are laid out, and that all franchises to use the streets are subservient to the rights of the public to use the streets for this purpose; that the people have the right to avail themselves of new and improved modes of travel, and when franchises are granted for this purpose they confer a right paramount to the franchise of a water or gas company, and if the operation of a street railway by electricity disturbs the working of a water or gas company the latter must readjust its methods to meet the new conditions as a matter of protection. Hence, if we adopt these conclusions as sound law, it will appear that the contest between electric railways and the water and gas companies over the use of the streets and the alleged damaging effects by reason of electrolysis must ultimately be settled by the ingenuity of inventors rather than by skillful and technical efforts of lawyers and courts. Notwithstanding the contest between electric railways and telephone companies has not as yet been definitely settled, it is true that the former have driven the latter to the adoption of devices and systems for the purpose of securing the best electrical results, and thus avoiding all danger of disturbance from the former. It is quite certain, therefore, that public convenience will demand that the streets shall be used for all the electric currents that may be required, yet it is the duty of the courts to protect existing property from unnecessary injury without needlessly obstructing the application of such a valuable force as electricity as a motive power for the public benefit. It is certainly true, as the courts have generally held, that no one mode of public service has a right to monopolize the earth or the air of a public street, but the power of injunction will only be exercised so as to avoid present injury to existing property until scientific and practical men find a way for all to operate in harmony free from negligence and wanton injury. Whether the power of restraint will be exercised even to this extent against electric railway companies for the use of water companies is not yet settled, and it may be that the courts will decide that in these particulars each and every company using the streets must exercise care and ingenuity to protect itself from the effects of intrusion by a neighboring system for lawful ends and by legitimate means, only insisting that each must use the best and most improved appliances practically available for producing the best results and the least disturbance.—Mr. R. D. Fisher in the Street Railway Gazette, Abstract.

IRON WIRE IN DYNAMO ELECTRIC MACHINES.

It has been pointed out as one of the triumphs of electrical engineering that the efficiency of the dynamo and electric motor is greater than that of any other type of energy transformer, and indeed has been brought to so high a pitch that little if any advance can be looked for. But having attained this desired goal it does not by any means follow that there is nothing left to be done in the construction of dynamo electric machinery. There are not a few who are striving for still further simplicity and capacity per pound of material employed, and, above all, for cheapening the cost of manufacture. It is with the latter object in view that Mr. Gilbert Wilkes—in a recent lecture delivered before the engineering students at the University of Wisconsin—recommends the use of iron wire both on the armature and fields of small machines, that is, not exceeding five horse-power.

It is certain that the winding of an armature with iron wire will materially reduce the reluctance of the gaps, and therefore will economize in exciting power, for two reasons: First, directly, by lessening the total reluctance of the magnetic circuit, of which the air gap is the most prominent portion, and, second, indirectly, by reducing the magnetic leakage of the machine, which is the quotient of the sum of the permenances of the stray paths by the permenance of the useful path, the latter being practically equal to the reciprocal of the reluctance of the gap spaces. Magnetically, therefore, the use of iron wire in the armature offers a great advantage over copper. On the other hand, it is to be considered that the electrical resistance of iron is about seven times that of copper, and that, therefore, for the same current output, the iron wire would require to have seven times the sectional area of the copper wire. This, of course, increases the height of the winding space, and consequently, the external diameter of the armature, which in turn will increase the size of the whole machine. Since the armature resistance will be practically the same if the cross section of the iron is chosen at seven times that of copper, the $C^2 R$ loss will be the same in both cases; but, the whole armature being one mass of iron in the former case, the energy-loss due to hysteresis and to eddy currents will be considerably larger, causing more heat generation than in a copper wire armature. If the size of the armature is such that this increase in heat is within the limits of the increase of the size of the radiating surface, then the temperature increase of the armature, in running, will not be materially different for the two materials of the armature wire. This consideration will at once determine the limits as to size of machine and of the application of iron wire to the armatures of small machines.

Another advantage of using iron wire in small machines is the increase of the effective length of the armature conductor. In order to limit the leakage across the polepieces, the distance between the pole corners must be larger than the length of the two gap-spaces; and since in small copper wound armatures this length is comparatively large, the distance between the pole corners is excessive compared with large dynamos, and therefore the percentage of the effective polar arc is very small in the small machines. In using iron wire, this distance between the pole-corners may be considerably decreased, and a larger portion of the armature circumference rendered useful, thus increasing the effective length of the armature-conductor, whereby—in a generator—a correspondingly larger E. M. F. output is obtained. It would thus seem that there are many advantages in favor of using iron wire for winding the armatures of small dynamos, and we, therefore, think it worth while to investigate this matter further by experiment.

As to the use of iron wire for winding the field cores, we fail to see any advantage. On the contrary, the winding of the magnets with iron wire would reduce their distance from iron to iron, and increase their iron surface, thus lessening, in a high degree, the reluctance between them. In the armature, this reduction of the reluctance is the chief advantage of the iron wire, as it applies to the useful path, while, if applied to a stray path, it becomes a most serious disadvantage, especially in small dynamos. For in these, the naked cores in themselves offer a comparatively much greater surface than in large machines, and the leakage between them is therefore much larger in comparison; and if this already large leakage is still further increased by winding the cores with iron wire the gain in using iron for the armature may eventually not only be entirely cancelled, but the leakage may be larger than when using copper wire. We therefore cannot agree with Mr. Wilkes in recommending the use of iron wire for winding the field cores of small dynamos, but we feel sure, that its application for winding small armatures will prove successful.—Electrical Engineer.

ELECTRIC WELDING.

In an article on electric welding and metal working in the Engineering Magazine, Mr. Herman Lemp gives some interesting facts regarding the growth of electric welding and the adoption of the process in many manufacturing industries. After describing several early methods employed, the discovery of the Thomson process and many machines used in welding different articles he says:

The practical application of the Thomson process to various industries will now be described briefly. Wire-mills were early to recognize the advantages of the electric process for disposing of their shorts, incidental to the manufacture of wire, on one hand, and satisfying the demand of the trade for longer coils. Automatic machines are mostly used for this purpose; that is, machines in which all conditions for good work are automatically maintained without requiring a special experience on the part of the operator. Nearly every wire-manufacturer of repute in the United States has either one or more of these machines. The firm of John A. Roebling's Son & Co., in Trenton, are making, on the average, 600 welds per day of ten hours, on telegraph wire. Most of the time is used in the handling of the heavy wire coils, as is seen by comparing the above output with the welding of brass wire loops and steel harness-rings done at the works of the Thomson Electric Welding Company, in Lynn, for outside customers; in which case the daily product of ten hours is 3,000 and 1,000 welds respectively. The increase in speed is simply due to quick handling of light objects as compared with heavy coils.

Mr. Roebling stated in 1892 that, of more than 1,000,000 welds made by the firm, not a single case of a bad weld had come to his knowledge. Carriage builders are largely users of the electric process. Tires, hub-bands, dasher-frames, carriage-steps, and axels are welded in large quantities.

The hand hydraulic pressure as used on some of the large machines may be replaced by a special pump and accumulator controlled by a valve. Both the clamping of the stock and the end pressure are hydraulic, relieving the operator of nearly all manual work. The manufacturers of metal wheels have also found it advisable to use the electric process.

The much dreaded welding of high-carbon steel, in the experience of the ordinary blacksmith methods, has in the Thomson process been rendered comparatively easy. This has been fully demonstrated by the Standard Tool Company of Cleveland, who are manufacturing reamers, twist-drills, taps, etc., in enormous quantities, the characteristics of which are that only the cutting part of the tool is composed of tool steel, while the shank is of a good grade of machinery steel. Not only is there a saving in the manufacture, but also a better product is obtained; the shank is tougher and less brittle.

Recognizing the utility of the electric process, not only for welding commercial pipe length into endless coils, but also applying the same process to locally heating sections of pipe for bending, a special company was organized, the Electric Pipe Bending Company, for making continuous coils of every description. In making continuous circular pipe the welder is mounted on a railway truck, and while the pipe, heated in a coke stove between welder and coiling apparatus, is gradually wound up in the latter, a new piece of pipe is welded to the traveling end.

An industry owing its existence entirely to the electric welding process is the manufacture of high-grade projectiles carried out by the American Projectile Company. By combining the welding process with forging and hydraulic pressing, a projectile can be produced which, in price, is nearly equal to the old and unreliable cast-iron shell, and which, in quality, far surpasses the latter. Official tests have proved the shells inferior to none, while in the method of manufacture there are possibilities to still further increase their efficiency without increasing the cost. The principle involved is, briefly, to unite two forgings, representing respectively the base and point of shell, by electric welding. The point can be made of very high carbon steel, while the body and base may be ordinary machinery steel.

An example of what a progressive mind will accomplish is given by the Johnson Company of Johnstown, Pa., who, under the able leadership of Mr. A. J. Moxham, have applied the electric-welding process in a manner that has almost startled its own projectors. I am not able to produce any photograph of the ponderous welding-machinery used in this work, but will only give a few figures to show the magnitude of their undertaking. There are, approximately, ten welders in use, of an aggregate of 1,200 horse-power. From 12 to 16 square inches are currently welded. A single weld of 48 square inches even has been produced. The product is railway switches, crossings, frogs, chairs, special rails, splice-bars, etc. All track constructions heretofore bolted are being replaced by welded together rolled structures, thus furnishing an excellent wearing, proof against being thrown out of shape by loosening of bolts or rivets.

The latest application—one which has cause no end of discussion, and which is past the experimental stage—is the welding of rail sections into one continuous track for electric street-car service. Mr. Moham has demonstrated that a continuous rail can be made, buried in the ground, and made to withstand the variations of temperature that are met with in this climate. At present he is carrying out the commercial laying of tracks electrically welded on the spot with apparatus furnished by the Thomson Electric Welding Company.

Experience, Mr. Hemp says, toward the end of the article, has established the following facts: A continuous 70-pound rail requires about 150,000 pounds strength to withstand the maximum strain put upon it longitudinally by the variations in temperature from the coldest winter to the hotest summer. An electric weld will only break at 279,000 pounds strain. Four joints can be made in an hour, under proper conditions. The electric conductivity of the joint is as great as the rail itself.

To sum up, electric welding has these indisputable advantages:

The heat is sharply localized to the point and metal near it.

The temperature obtained and required can be exactly regulated.

The rapidity of heating and its distribution can be controlled by simple means. Irregular forms can be welded in the desired relation of its various parts.

By this process all metals, as well as the alloys of all metals, are weldable.

The welding operation is carried on under the direct inspection of the operator.

The operation can be and often is made automatic, and the result is absolute uniformity; oxidized surfaces are excluded from the joint, and only clean metal unions made.

Pieces can be welded to exact size, and finished pieces may retain their finish during welding.

The process may be applied to pieces in place, as in track welding. Water-power may be employed for the work, or the cheapest fuels of lowest grade.

The greatest convenience and cleanliness attends the practice of the process.

The cost of fuel is not greater and generally less than in forge-welding, while the labor is reduced one half.

LEGAL NOTES.

DECISION AFFIRMED IN FAVOR OF CONSOLIDATED CAR-HEATING COMPANY.

Judge Swan, of the United States Circuit Court, at Detroit, in a decision rendered August 21st, denied the motion for a rehearing in the Cody patent case, thereby affirming a previous decision of the same court in favor of the Consolidated Car-Heating Company of Albany, N. Y.

STAR ELECTRIC COMPANY ENJOINED.

In the case of the Edison Electric Light Company and the Edison General Electric Company against the Star Electric Lamp Company, David J. Kennedy, Albert S. Terry and Franklin S. Terry, an injunction has been issued *pendente lite* against the defendants. The case was tried before Judge Seaman of the Circuit Court of the United States, Northern District of Illinois. The following is an abstract of the opinion of the Judge:

"This hearing is upon a rule to show cause why an injunction *pendente lite* should not issue against the defendants according to the prayer of the bill of the complainants.

"Infringement is unquestioned if the patent is alive with reference to the defendants. The only defense is that which was set up and maintained recently in the Circuit Court for the Northern District of Ohio, in the case of the Edison Electric Light Company against the Buckeye Electric Company (59 Fed. Rep., 691), viz., that the complainants are estopped from asserting as against these defendants that the patent extends beyond November 10, 1893, because a purported amendment in the Patent Office, dated December 18, 1883, appears to limit its existence to the term of the 'British patent for fourteen years, dated November 10, 1879.' It is undisputed that this amendment did not correctly show the date from which the British patent took effect; that the proceeding was taken under a mistaken view, and was not within the jurisdiction of the Patent Office; that it was expunged on March 13, 1893, and adjudications have settled that it was void and did not limit the term of the patent. * * *

"The defendant, the Star Electric Lamp Company, is a recent corporation, having legal existence only from March 18, 1893, which would be subsequent to the cancelation in the Patent Office of the alleged amendment of the patent. Within its own rights, therefore, it is clear that this corporation is barred from any of the benefits of estoppel which might arise in favor of one taking action and making large investments before cencelation.

"But the defendants contend that this corporation is simply an outgrowth and continuation of another corporation, the Sunbeam Incandescent Lamp Company, or, as stated in their brief, is 'a mere creature of the Sunbeam company,' having the same officers, stockholders and managers, and 'is, in fact, the same company under another name,' and being founded upon 'the same investment and interest' is entitled to any benefits of estoppel which would work in favor of the parent company.

"This statement may well be accepted as true, in the identity of the stockholders, management and investment, but the two companies have nevertheless separate corporate entities. * * *

"If, therefore, the showing made by the defense would primarily have constituted an estoppel in favor of the Sunbeam company through investment by its stockholders in reliance upon it—which is not here decided—that company was foreclosed by its agreement and acts, and the defendant corporation, which is masquerading here as a new company, with all the interests of the old one, cannot take the benefits of the old one without the attendant burdens.

"The complainant shows clear right to protection by an injunction *pendente lite*. The fact that the defendants have a large investment in a plant cannot be permitted to turn the scales against a case so made out. The individual defendants are properly made parties as officers of the corporation—president, treasurer and secretary respectively—and while an injunction against the corporation is binding upon its officers, it is proper to name them in the order or decree. The history of this litigation shows the value of such practice. An injunction will issue against all of the defendants according to the prayer of the bill."

Chicago Enterprises.

In the gossip which has been circulated on the street, the introduction of the Harrison telephone in the city of Chicago has been mentioned. It was reported that the company contemplated laying its wires under what is known as the Bacon Compressed Air Supply Co's franchise, which was secured something like a year and a half ago. Very little has been done under this franchise by the owners since it was granted by the city. It has not been stated of how great a value this franchise will be to a telephone company in competition with the present company, but it is doubtful if the franchise in its present form will be of very great value without some changes.

It is expected that a franchise will soon be asked of the City Council by the Chicago General Railway Company to build a road from Lincoln Park to Union Park, and also other branches of the line now operating on 22d street. It is said that the company has already solicited the assistance of property owners along the proposed route. The company will make many concessions in the way of reduced fare and transfer tickets. These lines will be built almost entirely on the West side, and the lines to Lincoln Park will carry passengers from the West and South sides without passing through the business district. But one fare will be charged for the trip, which will thus have an advantage over the present lines where two fares are charged.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

Elwood, Ind.—The Elwood Electric Street Railway Company will add 3,700 feet of track, overhead work, etc. O. B. Frazier is purchasing agent.

Goshen, Ind.—The Indiana Electric Railway Company contemplates numerous extensions and improvements. J. J. Burns, 185 Wabash Ave., Chicago, is president and purchasing agent.

La Fayette, Ind.—The La Fayette Street Railway Company proposes to extend its line two miles next year.

Dayton, O.—The Cincinnati, Middletown & Dayton Traction Company will soon construct a line from Cincinnati to Dayton, 60 miles; also one from Dayton to Columbus, 70 miles. Office of company, 9 Commercial Gazette Building, Cincinnati, O. Secretary, O. B. Brown, Dayton, O.

Fremont, O.—The Fremont Street Railway Company contemplates an extension of three miles of road.

Gallipolis, O.—The Gallipolis Street Railway Company proposes to relay three miles of its track. H. R. Bradbury, receiver.

Pittsburgh, Pa.—The Schenley Park & Highlands Railway Company has contracted for the erection of a power plant, to be completed about October 1 next.

McKeesport, Pa.—The McKeesport & Wilmerding Railway Company contemplates the construction of one and one-half miles of track. J. L. Devenny is purchasing agent.

Natick, Mass.—The Natick Electric Street Railway Company is about to make a seven-mile extension of its line.

Wakefield, Mass.—The Wakefield & Stoneham Street Railway Company propose to build a line from Reading to Stoneham. E. P. Shaw is purchasing agent.

Scranton, Pa.—The Lackawanna Valley Traction Company expect to have its line of eight miles completed by December next. P. S. Page is president.

Columbus, Ga.—The North Highlands Railroad Company will build and equip about five miles of road. F. E. Knapp is purchasing agent.

Sioux City, Ia.—The Sioux City Traction Company will extend its line in Greenville, and build a steel bridge across the Floyd river. J. C. French is president and manager.

Crisfield, Md.—The Crisfield Electric Railway Company have an exclusive charter for a line on several streets and roads in county. Its president, Thos. S. Hodson, 6 East Lexington street, Baltimore, Md., wishes to communicate with investors.

Winchester, Tenn.—The Winchester, Paint Rock & Tennessee River Electric Railway Company has let contract for the construction of an electric light plant, and an electric railway between Winchester and Decherd (Franklin county). Other roads are also projected, all to be built under the Robertson Insulated Conduit System of "Underground Trolley" Electric Railways.

NEW INCORPORATIONS.

Pensacola, Fla.—Citizens' Electric Light & Power Company, for operating electric plants for light, heat and power, on August 13; $20,000.

Chicago, Ill.—The Co-operative Electric Railway Company on August 11; $1,000,000.

Chicago, Ill.—Chicago Harrison Telephone Company on August 13; $4,000,000.

Chicago, Ill.—The Arnold Telephone Company, for the manufacture of telephone and electrical supplies, August 14; $1,000.

Chicago, Ill.—The Robertson Insulated Conduit Electric Company of Chicago, to operate street, horse and dummy railways, etc., August 15; $1,000,000.

O'Fallon, Ill.—The O'Fallon Electric Light, Power, Heat & Water Company, August 15; $20,000.

Chicago, Ill.—The Central Bell Telephone Company of Venezuela; $400,000.

Independence, Ore.—Gilmore Water & Electric Light Company on August 7, with capital stock of $30,000.

Danville, Va.—The Danville Telephone Company, with a capital stock of $25,000.

San Francisco, Cal.—The Sutro Railroad Company, to operate street railways, etc.; capital, $400,000.

Bernicia, Cal.—Solano Electric Light Company, to supply electricity and gas for light, power, etc.; capital, $10,000.

Cohoes, N. Y.—The Cohoes City Railway Company; $50,000.
manager, etc., 1612 Monadnock Block, Chicago.
furnish electric light, heat and power; $50,000.

Orange, Mass.—The Athol & Orange Street Railway Company, with authorized capital of $60,000.

Camden, N. J.—United Automatic Telephone Company; $40,000.

Chicago, Ill.—The parties interested in the Robertson Insulated "Underground Trolley" system have just incorporated the "Robertson Insulated Conduit Electric Company of Chicago," for immediate and active operations in Chicago, and at various points in Illinois, where franchises have already been granted. Farther information can be obtained concerning this system and its operation by calling upon J. Luttrell Murphy, general

Denver, Colo.—The Arkansas Valley Electric Company, to

Woodbury, N. J.—Citizens' Light & Ice Company, to manufacture electric light and power, ice, etc.; capital, $50,000.

Sea Island City, N. J.—The Electric Light, Power & Water Company of Sea Island City; $50,000.

Saratoga Springs, N. Y.—The United Gas & Electric Light Company of Saratoga Springs; $60,000.

Yonkers, N. Y.—Yonkers Electric Railway Company; $1,000,000.

East Rochester, O.—The Eastern Ohio Telephone Company; $500.

Pittsburgh, Pa.—The Pitcairn, Wilmerding & Braddock Street Railway Company, to operate street railways; $21,000.

Farmington, Pa.—The Farmington Telephone Company; $800.

Selinsgrove, Pa.—Sunbury & Snyder County Telephone Company; $5,000.

San Francisco, Cal.—Electric Advertising Company, to do advertising by electrical devices, August 3; $100,000.

San Francisco, Cal.—Eureka Electric Company, to manufacture electrical apparatus, on August 3, with capital stock of $100,000.

Ocala, Fla.—The Ocala Telephone Company, with a capital stock of $10,000.

Pontiac, Ill.—Pontiac Telephone Company on August 6, with capital stock of $3,000.

Crown Point, Ind.—The Crown Point Electric Company, for the construction and operation of an electric plant for furnishing electricity for light, heat and power.

Kittery, Me.—The Rockport Electric Power, Light & Heat Company, with $50,000 capital stock.

Asbury Park, N. J.—Seashore Electric Light & Power Company, with capital stock of $100,000.

Troy, N. Y.—The Trojan Telegraph Company of Troy, N. Y., with capital stock of $5,000.

Graysville, O.—The Graysville Telephone Company on August 3; $400.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Elwood, Ind—The Elwood Electric Street Railway Company will add to its equipment a 1,000-light alternating machine. O. B. Frazier is purchasing agent.

London, Ontario.—The Canadian General Electric Company has purchased the entire plants of the Forest City Electric Company and the Ball Electric Company.

Niles, Mich.—The city of Niles has purchased the plant of the Niles Electric Company. W. H. Tompkins is superintendent.

Brantford, Ontario.—The Brantford Electric & Power Company (limited) may largely increase its steam-power plant.

Superior, Neb.—The Superior Electric Light Company will install a 750 light alternating system at once.

Jackson, N. H.—The Wentworth-Hall Electric Light Company contemplates the addition of a 1,000-light alternating machine and a 50 horse-power engine. M. C. Wentworth is owner and purchasing agent.

Reading, Mich.—Mallory Brothers advise us that a plant will not be erected at present.

Richmond, Va.—B. T. August, city clerk, reports that no definite action has, as yet, been taken in the matter of a city plant.

Port Arthur, Ont.—The plant belonging to the Port Arthur Water, Light & Power Company was burned out on August 1 last.

Kalamazoo, Mich.—The contract for building the city lighting plant has been awarded to the Commercial Electric Engineering Company of Detroit, and application should be made to them by parties who desire to make bids for furnishing any portion of the same.

Spokane, Wash.—The City Park Transit Company, contemplates a two-mile extension of its line. Chester Glass is secretary.

Butte, Mont.—The Phoenix Electric Light & Steam Heating Company contemplates the addition of a mechanical stoker. C. H. Smith is purchasing agent.

FINANCIAL.

Although the general feeling among business men is that business is better during the past month, the number of failures of electrical companies has been greater than during any month of the year. Of the houses reported are, Queen & Co., Inc., Philadelphia; Ries Electrical Specialty Co., of Baltimore; Royal Arc Electric Company, New York; Knapp Electrical Works, Chicago, and T. W. Ness & Co., of Montreal. The failure of these houses cannot be charged to any causes peculiar to the past month, but is attributed to a gradual exhaustion of resources. The distribution of these failures shows that the causes are not confined to any one section of the country.

The settlement of the tariff question has occasioned little comment, the patience of business men having been exhausted some time since. It will, however, give traders and manufacturers more confidence, who have been hopeful of a good fall business. With manufacturers of electrical apparatus the contracts have been sufficient to keep them busy. Among the important moves during the month is the purchase of the Winstrom Electric Co., of Baltimore, by the Fort Wayne Electric Corporation and the turning of the Grant Locomotive works into an electrical factory by the Siemens & Halske company.

The electrical stock market has been very quiet. General Electric has received little attention from traders, and other stocks, although holding their own, have not been active. Traders have evidently been enjoying a vacation.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING AUG. 25.
Miscellaneous Securities.						
American Bell Telephone Co	Stock.	$17,500,000	100	....	J. Q.	195
“ “ “	Bds. 1893.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co	Com.	14,000,000	100	....	....	89
Commercial Cable Co	Com.	7,716,000	100	....	....	125
Edison Elec. Ill. Co., Boston	Com.	2,025,800	100	....	F. Q.	115
“ “ “	C. Bds. 1898.	71,000	100	6	M. & S.	.....
“ “ “	C. Bds. 1901.	586,500	100	6	M. & N.	.....
“ “ Brooklyn	Com.	2,500,000	100	....	Q. F.	85
“ “ “	1st. 1940.	500,000	100	5	A. & O.	100
“ “ “	Regis.	....	100	5	A. & O.	.....
“ “ Chicago	Com.	3,000,000	....	8	Q. F.	135
“ “ “		2,500,000	....	....	....	.....
“ “ New York	Com.	7,938,000	100	....	Q. F.	100
“ “ “	1st 1910.	2,562,000	100	5	M. & S.	107
“ “ Phila	Com.	1,473,000	100	....	....	128½
“ “ “		....	....	5	....	.....
Fort Wayne Elec. Co	Com.	4,000,000	25	....	....	3
General Electric Company	Com.	30,457,000	100	....	....	42½
“ “	Prf'd.	4,251,900	100	....	....	70
“ “	Deb. 1922.	10,000,000	100	5	J.-D.	86
Gold & Stock Tel. Co	Com.	5,000,000	100	....	Q. J.	....
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	90
Thomson Elec. Welding Co	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	....	....	.....
Thomson-Houston Elec. Co	Series D.	120,000	10	....	....	5⅝
Thom'n-Houst'n Intern. Elec. Co.	Com.	600,000	100	....	....	.....
“ “ “ “	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co	Com.	1,000,000	100	....	....	.....
“ “ “	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co	Com.	94,820,000	100	....	Q. J.	83
“ “	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	36½
“ “ “	1st Pf. Cum.	3,755,700	50	7	....	51
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R	Com.	6,000,000	10	....	Q.-J.	170
“ “	1st Bds. 1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R	Com.	500,000	100	....	Oct. 1.	.....
“ “ “	1st Bds. 1909	300,000	100	5	J. & J.	.....
“ “ “	Certf. 1894.	300,000	100	6	J. & J.	.....
BUFFALO—						
Buffalo St. Railway	Com.	5,370,500	100	5	....	.....
“ “	Bds. 1931.	5,000,000	100	....	F. & A.	.....
BOSTON—						
West End St. Railway	Com.	9,085,000	50	..	J. & J.	47
“ “	Prf'd.	6,4 0,000	50	5	J. & J.	77
“ “	Bds. 1902.	3,000,000	100	....	M. & N.	100½
LOUISVILLE—						
Louisville St. Railway Co	Com.	5,000,000	100	....	....	.....
“ “	Prf'd.	1,000,000	100	5	A. & O.	.....
“ “	1st Bds. 1930	6,000,000	100	....	J. & J.	.....
NEWARK, N. J.—						
Newark Passenger Railway	Com.	6,000,000	100	....	....	27⅜
“ “	Bds. 1930.	6,000,000	100	5	J. & J.	84½
NEW YORK—						
Union Railway Co	Com.	2,000,000	100	....	....	155
“ “	Bds.	2,000,000	100	..	....	.....
PITTSBURGH—						
Duquesne Traction Co	Com.	3,000,000	50		....	26
“ “	Bds. 1930.	1,500,000	100	5	J. & J.	103
Fed. St. & Pleas. Val. R. R	Com.	1,[illegible]	50	....	J. & J.	20
“ “ “ “ “	Bds. 1919.	1,250,000	100	5	J. & J.	102
Pittsb'gh, Aleg. & Man. R. R	Com.	3,000,000	50	...		37
“ “ “	Bds. 1931.	1,500,000	100	5	J. & J.	133¾
Pittsburgh & Birming. R. R	Co.	3,000,000	25		......	12½
“ “ “	Bds. 1929	1,500,000	100	5	M. & N	95
ROCHESTER—						
Rochester Railway Company	Co.	5,000,000	100	...	......	67
“ “ “	Bds. 1930.	3,000,000	100	5	A. & O	95
ST. LOUIS—						
Lindell St. Railway	Com.	2,500,000	100		Q. J.	94
“ “	Bds. 1910.	1,500,000	100	5	J. & J.	102
St. Louis & Suburban	Co.	2,500,000	400	....	......	14
“ “	Bds. 1921.	1,400,000	100	6	F. & A.	105
Union Depot Railway	Com.	1,200,000	100	....	......	150
“ “ “	Bds. 1910.	1,000,000	100	6	A. & O.	103

NEW BOOKS.

The Architect's Directory for 1894, containing a list of the architects in the United States and Canada. New York and Chicago: William T. Comstock. Price $1.00.

The publishers of this directory have placed in the hands of the trade and profession, a handy and useful volume. It contains not only a list of architects, classified by states and towns, but also a classified index of prominent dealers and manufacturers of building material and appliances. The officers of the American Institute of Architects and a list of the chapters with address of secretary are given. By a system of numbers the society to which the architect belongs is indicated. The index of manufacturers and dealers will be found very useful. The volume is compact and will occupy but little space on the desk or in the grip. The publishers do not claim absolute accuracy for the directory, for such would imply a power and ability more than is usually accorded to mankind. It shows, however, very careful and persistent work in an undertaking which is most difficult. What few defects there may appear in this edition, the publishers have taken pains to remedy as far as possible in subsequent numbers. The directory is to be published annually. It is bound in neat board covers.

Poor's Manual of Railroads, 1894, New York. H. V. & H. W. Poor. 2,000 pages. Price $6.

The 27th annual number of Poor's Manual of Railroads is still larger and more complete than previous editions. The maps and accompanying information will always be found of great value to all persons whether directly connected with railroads or not. Many changes which have occurred in railroad properties during the year has occasioned a large amount of extra work in preparing the matter for this edition. The authors have endeavored to present the financial condition of the various roads as accurately as possible. That part of the volume devoted to street railways has been considerably enlarged, and more complete data is given regarding railway properties. In the section designated as a department of miscellaneous corporations are compiled statistics of many of the larger corporations. These include many of the larger electrical companies; those conducting the telephone and telegraph systems and electric lighting stations. Many corporations manufacturing electrical apparatus will also be found in this department. These features of the book will make it more valuable to persons interested in electrical securities, while for persons dealing in general securities the book has been greatly improved and enlarged, including, as it does, data concerning nearly all of the larger business enterprises, municipal and county governments of the United States.

TRADE PUBLICATIONS.

Among recent publications received have been a number from the Correspondence School of Mechanics and the Correspondence School of Mines of Scranton, Pa. The circulars of information, or rather pamphlets as they contain nearly 100 pages, present very clearly the courses of instruction and the method of teaching. Many sample pages from the lessons are given which show their character and the aids that are given to assist the student. In whatever department a student may enter the plan of the school is the same—that is, a course of study that is systematic and conducted under the direction of competent instructors. There is a course of study for every class of mechanics. A classified list of students shows that students are taking these courses in almost every country and in every state in the union. To workmen or mechanics contemplating further study these pamphlets will be found of interest.

The Universal Index to the World's Technical and Scientific Literature is a publication which has recently made its appearance. It is to be a complete index of technical and scientific literature. Being published weekly it will be up to date in every respect. It offers to professional men and business men a work of reference that will at once indicate the current literature on any subject. New books as well as journals will be announced. It offers to the busy man a valuable help that will enable him to turn at once to the subjects that are of interest to him and to keep posted on the latest views and discoveries in any department. To publish in one pamphlet the entire index would form too large a publication and one that would be too large for convenient use. It has, therefore, been divided into four sections, the industries most closely allied being published together. Architecture and the building industry, engineering machines, appliances and the engineering industry and electrotechnical science and industry composes Section one in which the electrical fraternity will be interested.

One of the new catalogues received contains a description of the N. I. R. wires and cables of the many different kinds and sizes manufactured. The tables that compose a large part of the volume are carefully compiled, giving the various sizes of conductors with the different thicknesses of insulation, etc. The extensive list of wires enables purchasers to select that which is best suited to their needs. The company has been engaged for 30 years in the manufacture of insulated wires and has gained a high reputation. Every coil of wire is tested before it leaves the factory. A portion of the catalogue that attracts the attention of users of insulated wires is the report of the tests made of double conductor N. I. R. cable for Government service. The report of the test of the cable after a month's immersion in salt water is as follows:

"The double conductor cable submitted by the National India Rubber Co., Bristol, R. I., has been tested and is satisfactory. The resistance of the insulation is 2,270 megohms per knot. The cable was further tested by cutting off about ten feet and about 300 pounds weight hung to it, then knots were tied in it; it was twisted up tight and kinks made in it and hauled taut. In one kink the outside braiding was torn, but it was impossible to tear it again, though it was particularly tried. After this handling this piece was put in a barrel of water and tested for continuity and leaks. No injury seemed to have been done to the wires or insulation. The copper wires are tough and pliable and the tinning seems to be well done. Respectfully,

DUNCAN KENNEDY, Lieut. Com. U. S. Navy.

Naval Torpedo Station, Newport, R. I,, March 14, 1894."

PERSONAL.

Mr. M. E. Baird, of the Eddy Electric Mfg. Co., was in Chicago for a few days last month.

Mr. Geo. A. McKinlock has just returned from a short pleasure trip to Macinac Island.

Mr. G. Luthy, of the Royal Electric Co., Peoria, Ill., was in Chicago last month in the interests of his company.

Mr. W. A. Kreider, formerly with the Chicago Edison Co., has associated himself with the Chicago office of the Ball Engine Co.

Mr. James Wolff, formerly at the New York office, is now the Chicago representative of the New York Insulated Wire Company.

Mr. W. H. McKinlock, president of the Metropolitan Electric Co., was away last month for several days in the northwest, combining a business and pleasure trip.

Mr. W. R. Garton, well-known in the electrical circles, has accepted a position with Central Electric Company, and will have charge of the street railway department.

Mr. M. B. Austin, of the Knapp Electrical Works, has just returned from a four weeks' trip, combining business and pleasure, a portion of the time having been spent at Lake Delevan, Wis.

Mr. F. A. Gilbert, who has been president for five years of the Massachusetts Electric Lighting Association, was presented with a solid silver service at a recent meeting of the association.

Mr. A. B. Field, who for several years has been connected with the General Electric Company as salesman, has resigned his position with that company and will hereafter be identified with the Iona Manufacturing Company of Boston.

Mr. C. L. Pullman, the wellknown contracting agent of the Pullman company, has just returned from a three months' sojourn in the east, where he has been taking a much needed rest. Mr. Pullman's many friends will be pleased to learn that he comes back in the best of health, entirely recovered from his late indisposition.

Mr. James Paul Gaylord, president of the Pennsylvania Electric Engineering Company and Mathias Pfatischer, of the Electro Dynamo Company, of Philadelphia, are on their way to Zurich, Switzerland, on business of an electrical nature. They will be gone about two months, and while away will visit as many of the prominent manufacturers of lighting plants in Switzerland and other foreign countries as the time will permit. The latest practice in electrical engineering work will be studied.

BUSINESS NOTES.

MR. B. J. ARNOLD, consulting electrical engineer, has removed his offices from 436 to 574 and 576 The Rookery, Chicago.

WM. BARAGWANATH & SON, Chicago, have been awarded the contract for 1,500 horse-power feed water heaters for the Chicago City Railway Company's new electric railway plant.

THE CENTRAL ELECTRIC CO., Chicago, has secured the services of Mr. A. H. Goode, a gentleman well known in electrical circles, who will have charge of the company's electric light and power department.

OSBURN BROTHERS, 304 Dearborn street. Chicago, are carrying a complete stock of electrical specialties, dynamos and motors. The stock has been well arranged in the new store, and customers will find a variety to select from.

THE ROYAL ARC ELECTRIC COMPANY is in the hands of a receiver, Mr. Foster M. Voorhees. The indebtedness of the company is placed at about $80,000 with assets in the shape of patents on the incandescent lamp. These patents, which number 20 in all, were sold by the receiver August 8th.

THE WALLACE ELECTRIC COMPANY, 307 Dearborn St., Chicago, has had during the last month a large trade in railway supplies. The combination pole bracket, which affords a flexible support for the insulator, and the various other devices for overhead construction are favorites with railway men.

THE UNITED ELECTRIC CORPORATION, Minneapolis, Minn., is a new corporation recently organized under the laws of the State of Minnesota. The company will manufacture and deal in telephones and telephone apparatus. The president of the company is Mr. Samuel Grant, and the manager Mr. Paul W. Bossart.

THE NEW ENGLAND ENGINEERING CO., Chicago, Hoadley Bros. proprietors, has closed a contract with the Chicago City Railway Company for its new 12,000 horse-power steam plant, including boilers, engines, etc. This contract in for the extension of the electric railway system, and the work of construction will be begun at once.

J. A. MACHADO, agent, 203 Broadway, New York, can supply customers with Waddell-Entz apparatus. Arrangements have been made by which the dynamos and motors of this type will be built at Bridgeport, Conn. Mr. Waddell is still connected with the enterprise. The facilities for the manufacture of these machines is said to be the best.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison St., Chicago, has met with success in the introduction of the Arnold telephone, for which it is general selling agent. The company also reports a very satisfactory trade in Paranite and O. K. weatherproof wires. The company always carries a heavy stock of line material, and is able, therefore, to ship promptly orders of any size.

PULLMAN'S PALACE CAR COMPANY has resumed operations in all its various departments, the large proportion of the workmen being old employes of the company. In its street railway department the company is especially busy just now completing the numerous orders on hand for electric cars. The outlook is very encouraging in this department for a large increase in business.

ANDREWS & JOHNSON, 249 S. Clinton street, Chicago, repotr that their business at present is fully up to that of a year ago. This firm makes a specialty of ventilating apparatus. Among the contracts just completed is that of ventilating the Masonic Temple lodge rooms. In this installation the fans are all run by electric motors, three of which are three horse-power each, and one five horse-power.

THE ELECTRIC STORAGE BATTERY COMPANY of Philadelphia, it is reported, has closed a contract with the Edison company, of New York, for chloride accumulators aggregating 1,200-kilowatts. The cells will be of the largest size manufactured by the company, which have a capacity of 5,000 ampere hours. The plant is to be completed by October 1st. The chloride cell has been very successful abroad, and recent installations made in America point to a very prosperous career on this side of the Atlantic.

QUEEN & CO. INC., Philadelphia. an old established house, manufacturing instruments of all kinds, made an assignment on August 7th to Mr. John G. Gray, formerly manager of the company. The house was established by J. W. Queen in 1853 and has until recently done a most successful business. Mr. Queen sold out his interest a number of years ago to S. L. Fox and others. The company was incorporated in 1893. The officers of the company are: President, Samuel L. Fox; vice-president, E. B. Fox and secretary and treasurer, F. W. Stanwood.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, has just finished the complete equipment of an exchange at Cambridge, O., which is the largest yet established by the company. The exchange has no less than 110 subscribers and is reported to be in every way an entire success. The company is at present very busy in the manufacture of telephones and the equipment of exchanges. Among the exchanges recently equipped may also be mentioned the one at Webster City, Ia., another at Palatka, Fla., and still another at Chariton, Ia.

THE AMERICAN ELECTRICAL WORKS has its Chicago salesrooms at 241 Madison street now in order. A large stock of insulated wire is carried of the many kinds for which this company is well known. Mr. Francis E. Donohoe, who is the western representative, is now in the east on a business trip. The opening of this store will be a great convenience to the western trade, since it will enable customers to secure a quicker delivery of cables, wires or cords for electrical installations.

THE FOREST CITY ELECTRICAL WORKS, 17 and 19 Champlain St., Cleveland, O., is manufacturing in considerable quantities its automatic circuit braker switchboards, etc., and doing a general construction business. A specialty is made of copper commutator segments, which are manufactured from pure Lake copper. A ready market is found for these segments, which are of an excellent grade, being always flat, straight and true to gauge on account of the method of manufacturing. These works were formerly located at Geneva, O., but are now located in more commodious quarters at the above address.

THE BALL ENGINE COMPANY, Erie, Pa., at its Chicago office in the Rookery Building, has had, even in these depressing times, a fair amount of business. Among sales are: Peninsula Electric Light & Power Company, Houghton, Mich., one 350 horse-power tandem compound engine; Hotel Newcombe, Quincy, Ill., one 60 horse-power engine; Howe Pump & Engine Company, Ladd, Ill., one 50 horse-power engine; Industrial Home of the Blind, Chicago, one 80 horse-power engine, direct connected to General Electric dynamo, and Norton Bros., Maywood, Ill., two 150 horse-power Cross compound engines.

THE SIEMENS & HALSKE ELECTRIC COMPANY of America has closed six or more contracts for electrical machinery since the burning of its factory. Of these contracts one is for a large lighting plant in the Hotel Savoy, New York, and another, a power transmission plant, for Franklin MacVeagh & Co. These orders show the confidence of the trade in the ability of the company to supply promptly electrical machinery, notwithstanding the unfortunate fire which destroyed its factory. The new works of the company, leased from the Grant Locomotive Works, are already in operation, and the contracts of the company are being filled as rapidly as possible.

THE METROPOLITAN ELECTRIC CO., Chicago, is meeting with much excellent success in the introduction of its high grade incandescent lamp, called the "Metropolitan." This lamp is guaranteed to average a life of 800 hours of constant burning without a decrease in its illuminating qualities. It is also claimed to be a very economical lamp in the amount of current consumed. The demand for this lamp is constantly increasing, and the Metropolitan company expect a big trade this fall. The company reports a very satisfactory improvement in the volume of its business, and the outlook is most excellent. The I. X. L. wire, for which the company is western agent, is meeting with an increased sale.

THE INDEPENDENT ELECTRIC COMPANY, 39th and Stewart avenue, Chicago, while possessing exceptional advantages for the manufacture of electrical apparatus, fuse wire, etc., manufacture many specialties in other lines. Among these goods is the Whitely Exerciser, which is used by athletes, as well as professional men of sedentary habits. It is a whole gymnasium in itself, and is a thoroughly practical exerciser. It possesses the qualities that will bring it into use, easily carried and quickly put up in office or bedroom. Although the company gives considerable attention to the manufacture of these specialties, its facilities for doing experimental work and general electrical construction are not impaired, but on the contrary are being improved.

THE STANDARD PAINT COMPANY'S New York patents were sustained by the United States court for the District of New Jersey. The court held that the assignors of the above company were the first persons to produce a paper covered with a solid residium of petroleum and combining the characteristics of an odorless, water, acid, alkali and air-proof paper, and that the defendants in this suit, Henry J. Bird and James L. Reynolds, had infringed the patent. The court issued a decree giving the Standard company a permanent injunction against the defendants. The Standard Paint Company is one of the pioneer manufacturers of insulating materials for electrical machines and installations. Its products are widely known and are used by nearly all manufacturers of electrical goods.

THE RIES ELECTRIC SPECIALTY COMPANY, of Baltimore, Md., has made application for the appointment of a receiver to take charge of and close up the business of that company. Mr. Elias E. Ries, the president of the company, stated that the corporation is unable to successfully prosecute its business, owing chiefly to internal dissensions among some of its stockholders, and that the assets of the company are thereby in danger of being wasted to the prejudice of the creditors. Hence the petition for a receiver, who has been appointed with the consent of all parties for the purpose of dissolving the corporation and making an equitable distribution of the assets among the creditors and shareholders. The company was incorporated June 16, 1890, and has been engaged in the manufacture and sale of several well-known specialties, including the Ries regulating sockets for incandescent lamps. The company owns a number of valuable patents and a well equipped manufacturing plant occupying the entire building at No. 7 South Gay street. It is the intention of Mr. Ries to reorganize the company under more favorable auspices and to take up in addition to the inventions now controlled by it, the manufacture of some additional specialties for which there is a large demand.

THE WESTINGHOUSE ELECTRIC & MFG. COMPANY seems to secure a good percentage of the electrical business. Among recent contracts made is one for 1,800 horse-power of generators and necessary station equipment for the new power plant of the Second avenue railway. The business of the company for the last month is said to have been larger than any of the preceding months of the year which have reached nearly $600,000. The employes at the Pittsburg factory number over 2,000 and if the present increase in business continues more hands will be employed.

THE CONSOLIDATED ENGINEERING COMPANY, St. Louis, Mo., is to be congratulated on the contracts received for electrical plants. The contract for the municipal plant at Paducah, Ky., was recently awarded to the company for $17,316. The streets will be lighted by arc lamps for which it will require 120 2,000-candle power lamps. Standard Electric Company's arc machines will be installed and Hamilton-Corliss engines. The city furnishes the real estate and building and The Consolidated Engineering Company will install the lighting system and put it in operation.

THE CHICAGO RAWHIDE MANUFACTURING COMPANY, Chicago, is at present receiving a large number of orders from electric railway companies for its rawhide, pinions, bell and register cord, which are leading specialties of this company. In the factory is a handsome display of pinions finished ready for shipment, the quality and workmanship of which are especially worthy of mention. The long experience and standing of this company in the manufacture of such goods enables it to turn out the very best to be had. The outlook for increased business this fall is reported most promising.

THE HOPPES MANUFACTURING COMPANY of Springfield, O., is now busily engaged installing four of its live steam feed-water purifiers, of 3,000 horse-power total capacity, in the new electric station of the Lindell Railway Co. at St. Louis, Mo. The Hoppes company justly feels somewh t elated in securing this contract, as it was only secured after a hard fight and in the face of very strong competition. Among other recent sales we note the following: Live steam feed-water purifiers of 500 horse-power to the Procter & Gamble Company at Ivorydale, O.; 1,500 horse-power to the Indianapolis (Ind.) Light & Power Company; 150 horse-power to Wm. Coombs, of Coldwater, Mich.; 400 horse-power to the National Milling Company of Toledo, O.; 150 horse-power to the Cincinnati (O.) Street Railway Company, and 150 horse-power to Mr. Chas. H. Suppes, of Johnstown, Pa.

THE FALKENAU ENGINEERING CO., Betz building, Philadelphia, is the title of a co-partnership recently formed by Messrs. Arthur Falkenau, Edwin R. Keller, Clayton W. Pike and Elmer G. Willyoung, who are all known in engineering circles. The company will devote itself to designing and building light, heat and power plants, central stations and electric railways, and to give expert advice in all matters pertaining to the same. The experience of the members of the company, together with the technical education which each one received, has fitted them for any important engineering work. The company is at present putting in what might be called a model plant in the Bartram apartment house at 33d and Chestnut streets. The plant will have two 75 horse-power Woodbury engines, two 45 Kilowatt Mather direct connected dynamos, and will be wired for about 1,600 lights. A complete interior telephone system is being placed in the same building by them. A switch board of special design is being built for the Drexel Institute, which with much other work is keeping them busy.

CHAS. E. GREGORY CO., 47 S. Jefferson St., Chicago, report among the sales for the past month the following: Schneider Co., Garner, Ia., 60 light United States plant; Rud. Lafferty, Chicago, one horse-power C. & C. motor; Garner-Morgan Electric Co., Chicago, ten horse-power Detroit motor; J. W. Alber, Chicago, ten horse-power Crocker-Wheeler motor; Crane Elevator Co., Chicago, 25 K. W. Westinghouse motor and one horse-power Crocker-Wheeler motor; C. C. Travis, Lacon, Ill., 100 light Excelsior dynamo; Wilson & Jackson, Chicago, 8 light arc plant, 10 horse-power engine; C. R. Glaghorn, Conemaugh, Penn., 5 horse-power Crocker-Wheeler motor; R. Roach, Chicago, 210 light Edison dynamo; Garabaldi & Cuneo, Chicago, 1 horse-power C. & C. motor; Seeger, Guernsey & Co., Suc., City of Mexico, Mexico, 50 light U. S. dynamo, 100 light U. S. dynamo, and 1 horse-power Crocker-Wheeler motor; Geo. Cutter, Chicago, 1 horse-power Crocker-Wheeler motor, and 450 light dynamo (Westinghouse); Pontiac L. H. & P. Co., Pontiac, Ill., ½ horse-power motor; Jorden Show Printing Co., Chicago, 10 horse-power Edison motor; Capt. E. E. Napier, Steamer Mactawa, 5 light arc plant; Plamondon Mnfg. Co., Chicago, 60 light United States dynamo; C. Shotte, Chicago, 210 light Edison dynamo; Hatch Cutlery Co., Buchanan, Mich., 25 K. W. Edison motor and also 12 other electrical machines of different kinds.

ELECTRICAL INDUSTRIES.

Vol. V. CHICAGO. October, 1894. NEW YORK. No. 10.

Altanta, Ga.

The name of Atlanta is familiar to every American. It has been celebrated in song and story on account of the events which have occurred at and near it. These events, now matters of history, although of great importance from a political point of view, have not impeded the growth of the city, for progressive citizens from both the north and the south have united in building up the city. Its growth has been rapid. With one family in 1836 it has grown until it now numbers about 100,000 inhabitants. It is the capital of the state and also of Fulton county, and the public buildings and institutions are some of the prominent features of the city.

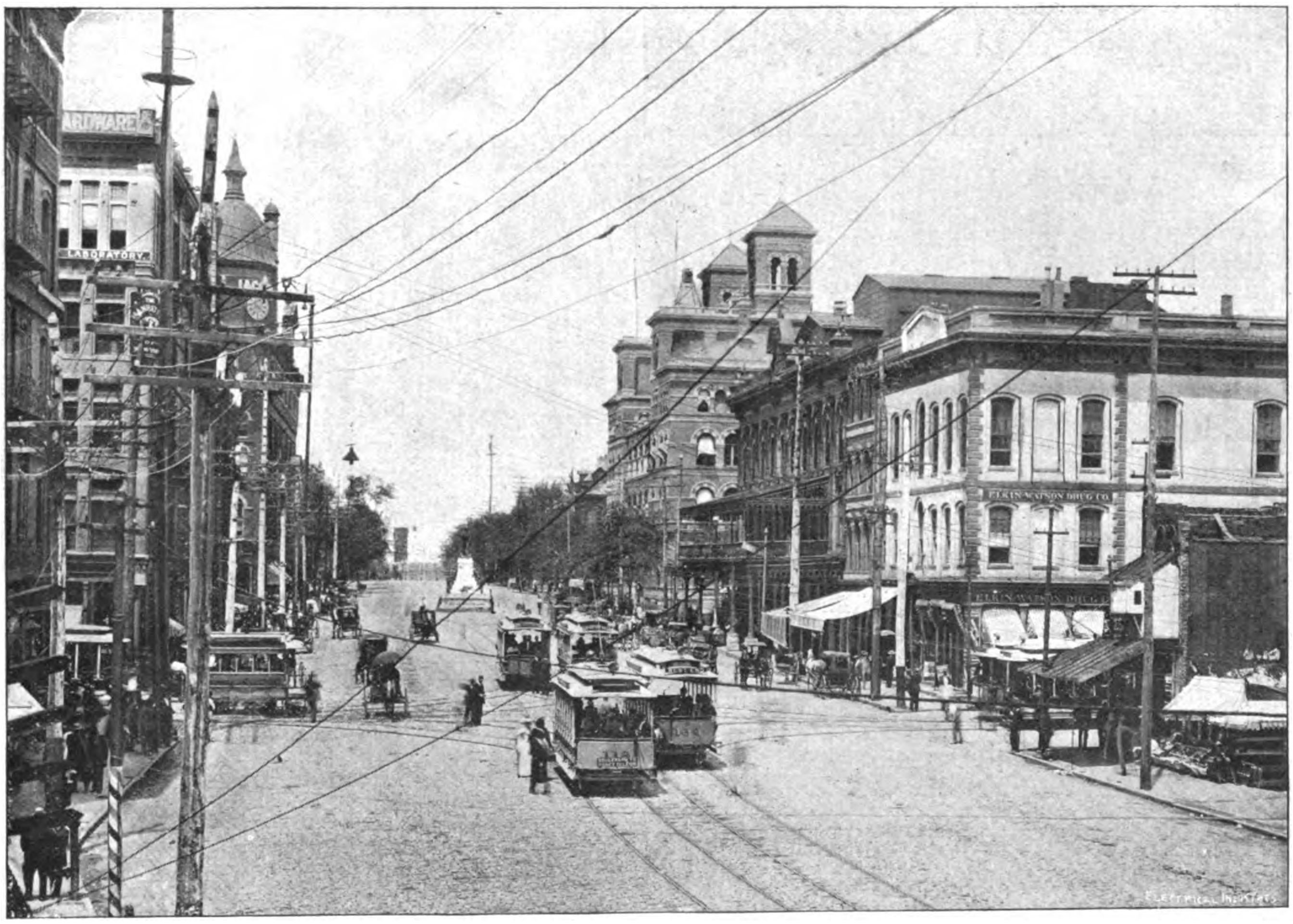


FIG. 1.—ELECTRIC RAILWAYS OF ATLANTA, GA.—PEACHTREE AND MARIETTA STREETS.

As a residence city it possesses exceptional advantages. It is located at an altitude of over 1,000 feet with a temperature ranging from 36 to 96 degrees Fahrenheit. The atmosphere is clear and the diseases which are peculiar to the south only appear in isolated cases. The city has many beautiful drives, parks and places of amusement. Piedmont Park, where the coming convention of the American Street Railway Association is to be held, is located just outside the northern limits of the city. These grounds are now leased to the Cotton States International Exposition, which opens in September, 1895.

Atlanta has every convenience of a modern city and its citizens take pleasure in the embelishment of the city. From a commercial point of view the city holds an important position in the south. Its wholesale trade aggregates $70,000,000 per annum. The railroad facilities are excellent, reaching in every direction.

Atlanta is a market for the staple products of the south. Its location in the cotton belt is advantageous in controlling a large part of the cotton crop. It handles annually nearly 300,000 bales. As a market for cotton it naturally handles a corresponding amount of the by-products, such as cotton seed, meal and oil.

Its business blocks and public buildings are modern structures. Through the generosity of citizens and the cooperation of the city and railway companies many beautiful parks have been constructed which are favorite points for recreation. The railway and lighting systems are prominent and well developed industries, as the succeeding pages will show.

The Electric Railways of Atlanta.

The history of street railways in Atlanta dates from 1871 when the first company was organized. In that year the first car was run, drawn by horses. Since that time the system has grown rapidly, until there are now more than 100 miles of road, a large part of which is operated by electricity. As the roads have been extended in all directions, they have also been improved. Experience showing the defects of the old methods, in the new work they were avoided, and the tracks were well built and well paved. Electric traction was introduced in 1888 on the Fulton County Street Railway, which was built by the T-H company. The overhead single trolley is used, and the usual methods of construction followed. The total miles of track now operated by electricity is about 75, of which 53 are owned and operated by the Atlanta Consolidated Street Railway Company, 18 miles by the Atlantic Traction Company, and 15 miles by the Collins Park & Belt Railroad Company. Other lines are projected to surburban towns near Atlanta, and electricity will undoubtedly be the motive power.

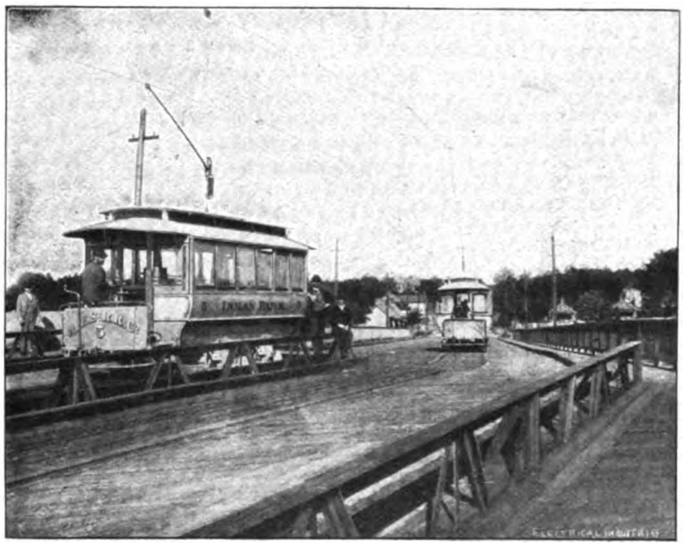


FIG. 2.—ELECTRIC RAILWAYS OF ATLANTA.

THE ATLANTA CONSOLIDATED STREET RAILWAY COMPANY was incorporated in 1891. It is a consolidation of the Atlanta & Edgewood Street Railway Company, the Fulton County Street Railway Company, the Metropolitan Street Railway Company, the Atlanta Street Railway Company and the Atlanta & West End Street Railway. Although some New York capitalists were interested in the roads, the controlling interest in the consolidated company is owned by Atlanta's citizens. The officers of the company are, president, Joel Hurt; vice-president, E. Woodruff; secretary, T. K. Glen; treasurer, R. J. Lowey, and general superintendent, H. N. Hurt. These gentlemen are prominent citizens and business men of Atlanta.

The lines of this company are divided into twelve routes, so arranged that the cars on each division pass a common point, the corner of Broad and Marietta streets. Forty cars are used, and are run on 15 minutes' headway on the different divisions. The cars are of several different makes, being composed of Stephenson, Brill, Pullman and Jones cars. Some of the horse cars have been refitted with a single motor, and are operated on some of the suburban lines. These small cars are fitted with conveyors, and no conductors are employed. Bemis trucks are in the majority on the regular electric cars. White men only are employed as conductors and motormen. The track laborers are colored men. The same cars carry both white and colored persons, the former usually occupying the forward seats.

The track work is necessarily of a different character, the different parts of the system having been constructed by different companies, but since the consolidation an effort has been made to bring the different parts of the line to the same standard of excellence. The rails are T and several forms of girder. The T rails, except on the suburban lines, are laid on wooden stringers, and on the suburban line are spiked to the ties. The stringer method has stood remarkably well. The electric girder rail, with the Johnson standard joint, has been adopted for all future construction. The streets in the center of the city are paved either with Belgium block or asphalt. The Belgium blocks come from Stone mountain, which is visible from Atlanta, being but 16 miles distant. This is considered one of the finest granite quarries of the world. The tracks on the streets paved with asphalt, are lined with granite blocks. Where T rails are in use the blocks are laid flush with the rail, and the flange of the wheel cuts its own groove.

The trolley wire is suspended from side poles, except about five miles of the road. The equipment is largely of the T-H type. With the exception of four Westinghouse 30 and two G. E. 800, the motors are T-H S. R. G. 15 horse-power. The power house which furnishes current for the road is located about three miles from the center of the city, on the line of the Richmond & Danville railroad. It is but a short distance from the exposition grounds, and will supply the building with power during the convention of the American Street Railway Association. The power house, which is one of a group of buildings located here, is a one story building, built of brick, with a truss roof. A railroad siding delivers coal into the boiler room.

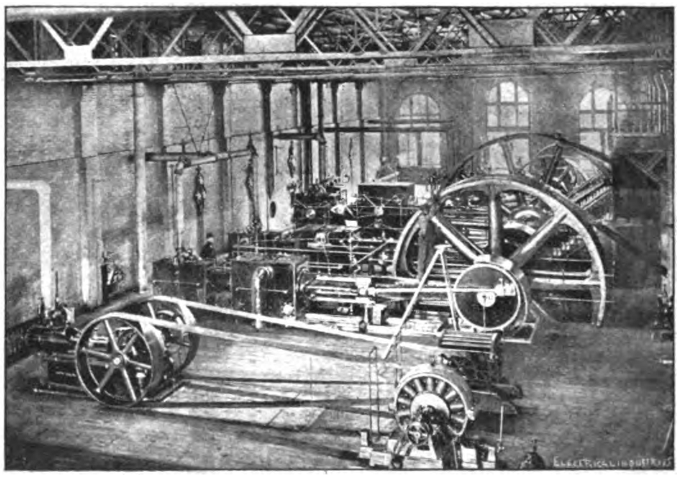


FIG. 1.—GEORGIA ELECTRIC LIGHT CO.—ENGINE ROOM.

Steam for the plant is generated in three Bigelow boilers, of 150 horse-power each, made in New Haven, Conn., and a Manning vertical boiler of 250 horse-power. The engine room contains two C. & G. Cooper Corliss engines and one tandem compound condensing Rankin & Fritsch 800 horse-power engine, two 300 kilowalt and one 500 kilowatt Westinghouse railway generators. The switchboard and station instruments and appliances are of modern and efficient design. The feeder cables are all of the Standard Underground Cable Company's make. There are sixteen of them that leave the station. The coal burned at the station has been a Tennessee slack, costing less than $2 per ton.

The company has a number of car barns located at convenient points. Two barns are near the power house, where are also located the shops and foundry, at which nearly all the supplies used by the company are manufactured.

The company casts its car wheels, brake shoes, trolley wheels, gears and numerous other parts and appliances. The machine shop and foundry is equipped with a full outfit of machines and tools with which to do the work. In fact it is possible to build a complete car at these shops. The facilities for repairing the motors are excellent, and many of the methods pursued in winding and repairing electrical machinery have originated in these shops. Although some repairs and supplies can be purchased at a lower cost, yet nearly all are made by the company. The members of the association will probably take a considerable interest in a visit to this part of the road's equipment.

ATLANTA TRACTION COMPANY,

incorporated in 1890, is a consolidation of the Atlanta, West End & McPherson Barracks Railway Company and the Grand Park Electric Railway Company. The lines owned by this road include a line to Decatur, eight miles from which a branch leads to East Lake, two miles farther. A line to Ft. McPherson, a government military post, six and one half miles, and to Grant Park, two and a half miles. It is a single track road with turn-outs. Owing to decrease of business the company was unable to meet the interest payments on the bonds of the road and receivers were appointed in May last by the court, Messrs. E. B. Rosser and W. C. Hale.

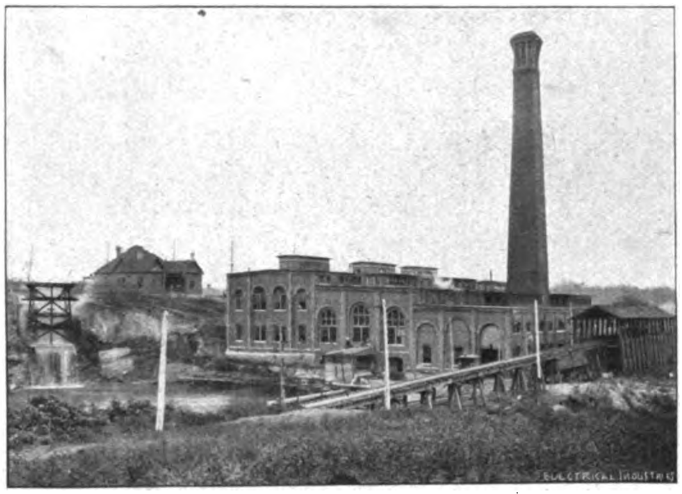


FIG. 2.—GEORGIA ELECTRIC LIGHT CO.—POWER HOUSE.

This road has two power houses; one located on the Ft. McPherson line and the other on Irwin street. On the Ft. McPherson line are located the power-house, car barn, repair shops and also the offices of the company. The boiler room contains two McLaughlin vertical boilers of 125 horse-power each, one horizontal Russell boiler, a Wainwright feed water heater and the necessary pumps. Coal is delivered at the door on a railroad siding. In the engine room are two Russell engines, one of 280 horse-power and one of 125 horse-power. From the larger is belted two 110 kilowatt Eddy M. P. generators. An 80 kilowatt Edison generator is belted to the smaller engine.

At the Irwin St. power-house the equipment consists of two Walsh & Widener boilers, of 180 horse-power each, a Berryman heater and the pumps. The engine room contains two 125 horse-power Russell four valve engines, belted to two 80 kilowatt Detroit generators. The station is provided with everything necessary for its protection and operation. Garton-Daniels lightning arresters are used on the lines.

The cars used by this company are Brill and American, mounted on McGuire and Robinson trucks. The motors are Sprague, Edison, Detroit and two recently purchased Westinghouse equipments. The track is laid with 40 pound T rails.

COLLINS PARK & BELT RAILROAD COMPANY

was organized in 1891, to develop the country lying west of the city of Atlanta. The line reaches out 10 miles to Bolton, a small suburb. The line is single track with turnouts. The route is lined with pleasant picnic grounds, which is not a small part of the traffic of the road. The company has started a funeral service, furnishing cars and transportation to a cemetery near the western end of the line. The road has 15 miles of standard gauge track, laid with 56 pound T rails. The rails are spiked to the ties.

The road was an expensive one to build, requiring in the fitting of the bed many heavy cuts and fills. This is undoubtedly one of the causes of the embarassment of the company. The road has for some time been in the hands of a receiver. Mr. J. W. Darr was appointed by the court and has since managed the property. There are nine motor cars, Brill, equipped with Short motors in use. The power-house is located near the middle of the line. It is built of stone, and 100 by 60 feet in size. There are two Allis Corliss engines operating Short dynamos. The boiler room contains three horizontal tubular boilers furnished by E. H. Jones of Cleveland. The equipment of the station is much in excess of that required by the present size of the road.

To its excellent systems of transportation Atlanta is largely indebted for its rapid growth. They have been a connecting link which has bound the suburbs to the city and made residence at a distance from the business district possible to all who so desire. The men who have developed this industry have not all been successful, but from the results of their energy and push the city and future owners will reap a benefit. In the development of the outlying districts, the construction of the parks and pleasure resorts, the railway companies have been active, and also in providing suitable and convenient transportation for those who frequent these pleasure grounds.

The depression of business has been felt in this state as in other parts of the Union, and has affected the railway industry in a similar manner. The return of more prosperous times will probably restore the roads now in the hands of receivers to the officers of the companies. The construction of additional lines of road has been stopped on account of the condition of business, but we may expect before long a greater activity in the railway industry of Atlanta.

Berlin, Germany, has 8,800 arc lights, 172,067 incandescent lights and 322 electric motors operated by current from central stations. These figures show an increase over previous years in the use of the electric light while the consumption of gas as shown in the same report has decreased. During the year 1893 there were one million cubic feet of gas less than in 1892 consumed. Up to the year 1893 reports had shown an increase in the consumption of gas, but the percentage of increase was diminishing. This decrease in the consumption of gas is credited to the prevailing unfavorable conditions of trade and the competition of the electric light, the use of which is constantly increasing.

Georgia Electric Light Company.

The plant of this company is located on the outskirts of the city and is one of the largest and most complete lighting plants in the entire south. Current is not only furnished for arc and incandescent lights, but also for power purposes, power being furnished to operate a part of the Atlanta Consolidated Street Railway Company's system, and to operate machinery in factories, printing offices and other establishments, also for the operation of elevators and electric fans in office buildings and residences.

The building is fire-proof, being constructed of brick and iron, and is built in three sections as shown in the accompanying illustration, Fig. 1. The first section shown on the right in the engraving is the boiler-room, while the engine-room, which is open to the ceiling, occupies the middle section of the first floor, and the left-hand section is occupied by the counter-shaft, from which the generators, located on the floor above, are driven. Communication is had from the boiler-room to the generator-room by means of stairs and arched openings through the brick walls. Near the station is a small lake from which the water for condensation is drawn, there being on the shore to the left a cooling tower with successive platforms covered with brush, through which the hot water descends, after being pumped to the top platform, whence it returns to the lake.

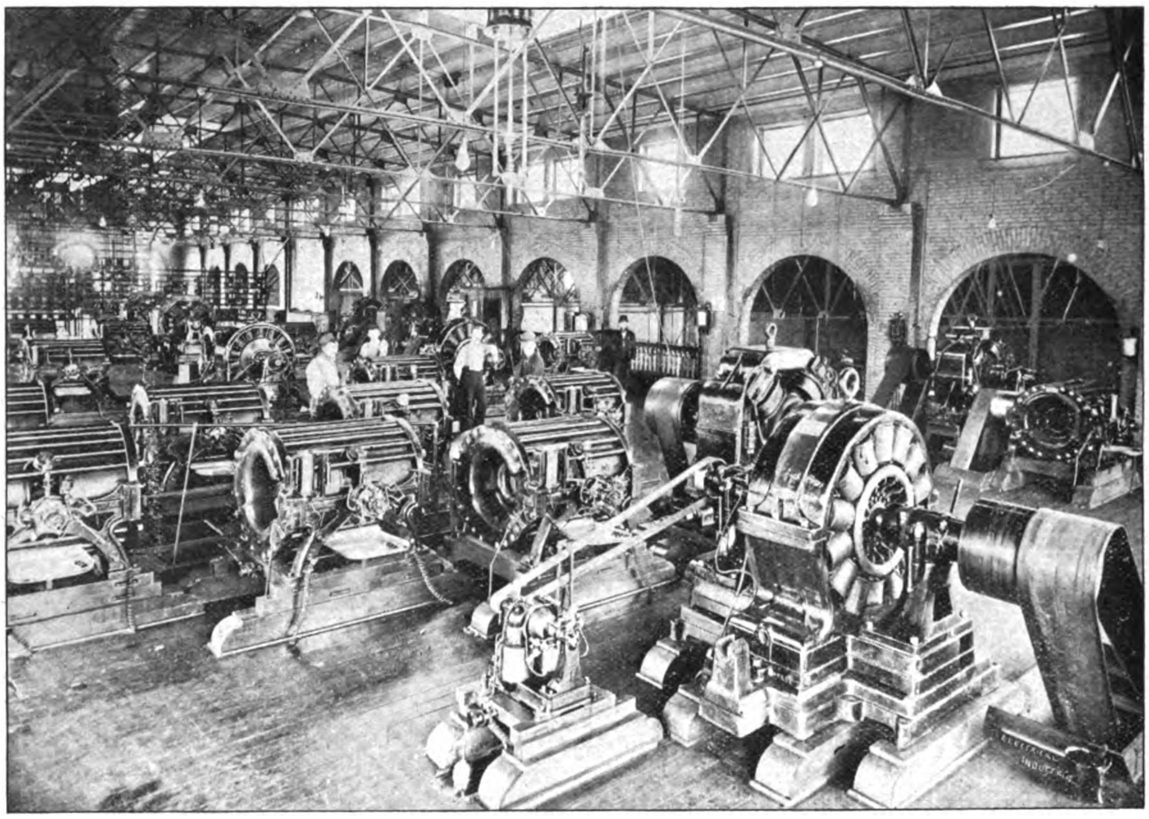


FIG. 3.—GEORGIA ELECTRIC LIGHT CO.—DYNAMO ROOM.

The lake is about fifty feet in depth, being an old quarry excavation, but which has filled from a subterranean stream, the water being pure and excellent for boiler purposes. Coal is delivered to the boiler-room from the tracks of the railroad company about one-half mile from the station, by means of an electric locomotive and special coal cars, run over an electric road, owned and operated by the company. To the right of the building is a coal chute, containing five hundred tons of coal, which is kept in stock in case of an emergency due to strikes.

The power equipment consists of nine return tubular boilers of the Bigelow type, in which soft coal is employed as fuel. These boilers are 250 horse-power each, making a total of 2,250 horse-power. The entire engine equipment aggregates 2,825 horse-power and consists of two pair of tandem compound 500 horse-power McIntosh and Seymour engines, each pair standing side by side and coupled to the same shaft, which carries a 14-foot fly wheel from which power is communicated by means of a 40-inch belt to one of the counter shafts. There is also one Harris-Corliss tamdem compound engine of 800 horse-power, with a 20-foot fly-wheel and 48-inch belt, and one pair of tandem compound Greene engines of 450 horse-power each and an Armington and Sims engine of 125 horse-power, the latter being non-condensing. Both Deane, McIntosh and Harris jet condensers are employed-

The generator equipment consists of four multipolar M P. 80 generators of the T-H type, which are owned by the Atlanta Consolidated Street Railway Company, and which supply power to their lines. There are also two multipolar M. P. 100 generators of the General Electric type, which supply current for power purposes over special lines.

The lighting plant consists of nineteen M. D. T-H arc dynamos, which supply current to 514 2,000-candle-power arc lamps, and 556 75 candle-power incandescent lamps for street lighting purposes. One hundred of these arc lamps are used for commercial purposes, and the other 414 for street lighting. There are five alternating dyamos of the T-H type, with a total capacity of 8,300 lights, which supply current for incandescent lighting, there being over 11,000 incandescent lights connected. The company is also making a specialty of of alternating arc lamps, and on September 1st had about 70 of these lamps in use on the meter system. They have opened up an entirely new field of lighting and have not, with very few exceptions, replaced any incandescent lights.

The Alternating Current, Its Generation and Distribution.—I

BY PROF. GEO. D. SHEPARDSON.

The present series of papers is called for by an apparent lack in the existing literature on alternating currents. Much has been written upon the subject from a mathematical standpoint. Many learned discussions of various special problems have appeared. Almost without exception these papers presuppose on the part of the reader a considerable amount of knowledge on the subject. One who wishes to begin the study of alternating currents, has difficulty in obtaining suitable guidance, because the books are above his experience, and he cannot read them intelligently until he has obtained some preliminary or introductory knowledge. The catalogues and instruction sheets of manufacturing companies give some light upon the subject, if one is so fortunate as toobtain them. Even these give only a limited treatment of the subject as it pertains to the operation of their own particular apparatus. As one means of helping beginners in the study of alternating currents, the writer has undertaken to prepare for publication some of the lectures before the students in electrical engineering at the University of Minnesota. The plan adopted is to give the students a brief elementary and general discussion of the more common phenomena of alternating currents before studying the subject analytically and in detail. In order to be of more service to those who have not had the preliminary mathematical training, and the acquaintance with direct currents enjoyed by the students, these papers will be more elementary than the lectures.

For ordinary purposes, such as lighting, heating and distribution of power by electricity, either continuous or alternating currents are employed. The most common use of electricity, aside from bells and light signal work, is for lighting by incandescent lamps. These may be operated either in series or parallel, and by either continuous or alternating currents.

For lighting on the parallel system, sometimes called "multiple" or "multiple arc," comparatively large wires or "mains" are run from the source of electrical supply to the point at which the lamps are to be used. Each lamp is connected to the two wires, or branches from them, and takes its own current independently of the others. Any lamp may be lighted or extinguished by simply turning a key or throwing a switch, which closes or opens the circuit. In such a system the two mains are kept at a certain difference of potential or pressure, and the current depends upon the number of lamps lighted. With continuous currents it is common practice to keep up a pressure of about 100 volts between the two mains. The lamps used have such a resistance that when connected to the mains, no more or less current can pass through them than is required to heat the carbon filament to the desired temperature and brightness.

Large plants which cover considerable territory often use the "three-wire system," which consists practically of two separate systems having one wire in common. The common or "neutral" wire is the positive side of one system and the negative side of the other, so that it carries only the difference between the currents on the two sides and not their sum. Recently a few manufacturers have placed upon the market a new incandescent lamp designed for 200 or 220 volts. These lamps may be connected directly across between the outside wires of a three-wire system. Their use avoids the complication of wiring to the neutral, and the difficulty of keeping the load balanced and keeping up exactly the same voltage on the two sides of the system. At this point it will be desirable to consider the reasons for using higher potentials. The energy lost in transmitting a current of electricity along a wire is independent of the voltage, if there is no considerable loss by leakage. The loss of energy is proportional to the resistance of the line and the square of the current. The loss in voltage or "fall of potential" on the line is, by Ohm's law, the product of the resistance and the current, or expressed in common symbols, $e=C.R.$ The energy or the watts lost equals the product of current and lost voltage or, $w=C\,e$. Whence the energy lost equals the product of the current, by the current and by the resistance. The total power transmitted is the product of current by total volts or, $w=C\,e$. It is evident that we may keep the horse-power or total energy constant even if the current and voltage vary through wide limits, so long as their product remains constant. It follows that with a line of a given resistance, if we double the voltage and halve the current in order to transmit the same amount of energy, the loss of volts on the line is halved. Since both the current and the lost volts are halved, the watts or energy lost on the line is quartered.

For an example, suppose it is desired to transmit 1,000 watts 500 feet on a No. 10 wire. The resistance of the wire out and back, 1,000 feet, is 1 ohm. Suppose the 1,000 watts is made up of 10 amperes at 100 volts. The loss of potential on the line will be amperes multiplied by ohms, or, $e=10x10=10$ volts. The number of watts lost is current multiplied by volts, or, $w=C\,e=10x10=100$ volts.

Now, suppose, that the same amount of energy is transmitted the same distance on the same wire by 5 amperes at 200 volts. The volts lost on the line will be amperes multiplied by ohms, or, $e=5=5x1$ volts. The number of watts lost will be amperes multiplied by volts, or, $w=C=e\ 5x5=$ 25 watts.

A further consequence is that if it is desired to lose the same amount of energy on the line, the wire may be only one-quarter as large if the voltage at dynamo or distributing point be doubled. Again, to use the same amount of energy on the line, and use the same amount of copper on the line, the wire may be made of half the sectional area, and be twice as long. In other words, with the same investment of copper wire, if the voltage at the station is doubled, the energy may be carried twice as far. Also with the same expenditure of copper per square mile, four times the area may be reached. In practice this is limited by the fact that the cost of the copper alone is but a fraction of the total cost of a line. The insulating covering of the wire costs as much as the wire itself in many cases, while the cost of poles and erection is much more unless several lines run on the same poles.

It is plain that the use of high potentials enables a greater distance to be covered with a given outlay of capital. Where long distances must be covered, comparatively high potentials are unavoidable.

The use of high voltage for transmitting electrical energy to a distance, involves difficulty in its distribution for incandescent lighting. Until recently it has been found impracticable to make an incandescent lamp for more than 125 or 150 volts. At present the limit seems to be about 225 volts. This would limit the voltage practicable for incandescent lighting, unless an extension of the three or five-wire system be used.

For some purposes, such as lighting streets or other large areas, lamps may be connected in series so that the same current goes through a group of lamps. One difficulty with such an arrangement is that if one lamp breaks or is turned off, the current is cut off from the whole group or series, unless some device is provided for short circuiting the faulty lamp and substituting an equivalent resistance. Another difficulty is in getting lamps that require the same amount of current for normal incandescence. Unless the lamps in a series are so matched, some will receive too much and will quickly be burned out, while others will burn below candle-power.

A third objection to the use of incandescent lamps in series is the danger from introducing high potentials into houses where people may accidentally or carelessly come into contact with the wires. By careful installation and maintenance danger of this sort may, however, be reduced to a minimum.

The liability to leakage, due to weakened insulation, is greater with high potentials than with low. On the other hand there is more danger from overheated wires and melting fuses with the larger currents used with low potentials, for wiremen and contractors are more tempted to put in too small wires if comparatively large ones are needed.

It is possible to transmit the electrical energy at high voltage to the distributing points,and there transform it into larger currents at lower potential. With continuous currents this may be done by a motor and generator belted or coupled together, or a dynamotor may be used having practically two armatures on the same shaft, one working as a motor at high potential, and driving the other as a dynamo or generator for low potential. Such a device with moving parts demands more or less constant attendance and expense.

The alternating current is specially suited for transmission at high voltage, and distribution at low voltage. The transforming device has no moving parts, and requires no attendance. A certain amount of energy is continually absorbed by it, and dissipated as heat, but not more than is so used by an equivalent dynamotor for continuous current.

The common practice in this country is to transmit alternating currents for incandescent lighting at 1,000 or 2,000 volts, and to transform and distribute it at 50 or 100 volts. Where long distances are covered, 5,000 or even 10,000 volts are used. A pressure as high as 30,000 volts was used experimentally for carrying about 150 horse-power 108 miles. Some experiments will next be shown to illustrate differences between direct and alternating currents.

What I Don't Know About Electricity—Third Paper.

BY GEO. CUTTER.

An off-hand style of considering some of those problems which appear very plain up to a certain point then become difficult and uncertain, seems to grate on the nerves of some electrical engineers. It certainly seems plain to me, however, that such an engineer should be as careful of the proper use of his profession in criticising these off-hand considerations of some of the interesting problems in our loved science as was the writer of the off-hand articles himself. There are many very interesting problems in our science that are being considered by various styles of men, having varied interests in their solutions, and I enjoy reading and hearing the style of thoughts upon these problems from different men. An off-hand style of exposure of such thoughts often excites new ideas thereon, and sometimes results in broadening our ideas more than some very elaborate calculations and theories.

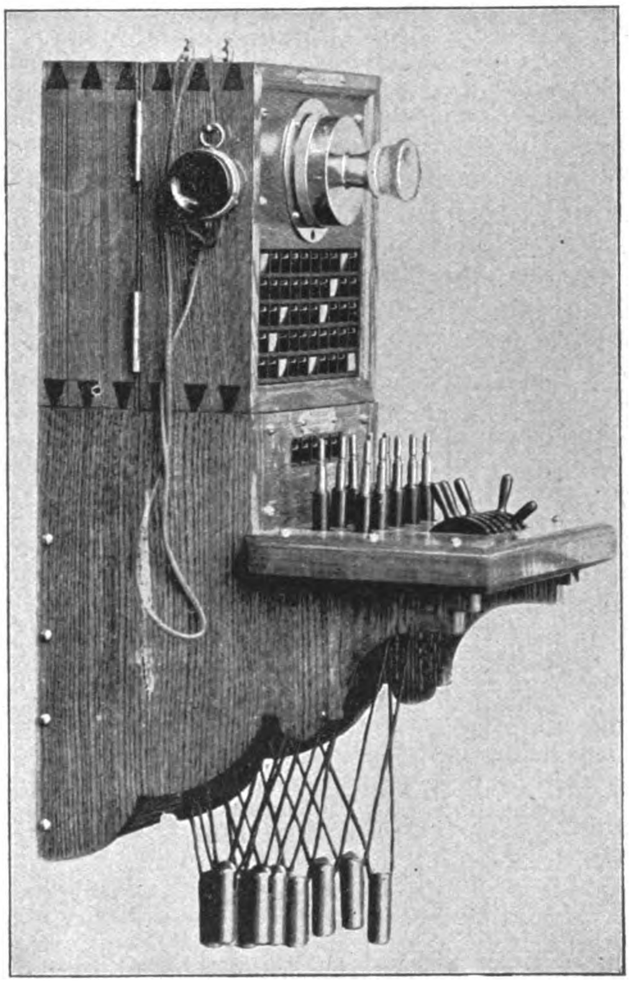
It is amusing to see how electrical engineers drift occasionally into peculiar and untenable positions, the absurdity of which must certainly occur to them upon little more thinking. The two critics of my former "don't know" articles have probably repented ere this for appearing in print in such unprofessional style. I am as much opposed to primary battery schemes as my friend Grier can possibly be, but must I fail to consider proper and legitmate uses of the primary battery because swindlers are using them to catch suckers? That a primary battery plant can be installed for lighting an isolated residence of light load so as to give great satisfaction both as to lighting results and the cost of same, is so plain from what has already been done in this line that a suggestion of its practicability should lead to the designing of such plants by able electrical engineers instead of condemnation on the grounds that such suggestion would encourage the primary battery swindlers.

My friend Grier will live to see such plants offered for sale by good reliable parties and very many of them installed. A great big business can be done in them whenever put up in such shape as to cover the conditions properly. As these plants will be limited to small work we of course must also be ready to furnish gas engines, steam plants, etc., for still larger plants, even these being quite small. Now my friend Broadhead comes in and makes fun of me for saying that we make our electricity for nothing by placing an engine in the path of the steam used to warm the house. My suggestion was correct, viz: That by designing a plant for the purpose so as to use our steam to the best advantage and concentrate all our coal consumption we can do all our lighting, heating and cooking in an isolated residence for very little in excess of the cost of heating and cooking by the old style. The difference in efficiency being *well nigh sufficient* to cover the extra power. Put up these plants ready to install, viz: Complete outfits, and a good market can be found for them. Of course those residences that are within reach of central station circuits have little need for these isolated plants. There might be a slight economy in operating an isolated plant as compared with the cost of lights from a central station, but this economy is only temporary, as the growth of the business will enable central stations to furnish lights at less cost. The tendency of modern times being to concentrate the work in our busy cities so the householder secures water, gas, electricity, etc., from a central plant furnishing same.

This concentration of the work for our cities will continue until nearly all the cooking, heating, lighting, etc., in our homes will be done with electricity, supplied from large stations. At present our American cities are very poorly laid out for the work done in them. It is so absurd to have large warehouses in the center of our large cities and innumerable trucks hauling goods from railroad depots to warehouses and back again. Oftentimes the goods go out at the same depot at which they arrived. A large central warehouse system with all railroads connected with same would wonderfully simplify handling goods that are merely centralized for subsequent shipment about the country. This would relieve our citizens of the large, heavy trucking which blocks our streets and uses up our pavements. No goods should be brought into the city except those intended for consumption in the city and the retail trade. When electricity is brought to the city from large water-power or coal-beds, it can be used to distribute goods about the city and relieve the streets of so many delivery wagons. Then our cities will be comfortable to move about in, the streets being quite clear of anything but conveyances for the people and our citizens on foot. This is an idea of a city thoroughly adapted to all requirements of city life and easily kept in first-class condition in spite of political hindrances.

The Cambridge Telephone Exchange.

Telephone exchanges have increased rapidly during the past season. Recent improvements in the telephone and telephone apparatus and the opening of the field to competition has given an impetus to the industry. The privilege of purchasing the instruments at a reasonable figure has also been a great inducement to the use of the telephone which herefore could be secured only by leasing. The compact and substantial form in which the new telephones are constructed permits them to be placed in any part of the office or residence.



THE CAMBRIDGE TELEPHONE EXCHANGE.

The exchange of Hoyle & Scott at Cambridge, Ohio, which is equipped with modern instruments throughout, was recently opened. The telephone is not new in Cambridge, a Bell system having been previously operated. The subscribers connected with "central" now number 111 and more will be added. The operation of this exchange, although recently completed, is said to be perfect in every respect. This together with the low cost to subscribers of this system is one of the causes of its adoption.

The old rates paid were $50 per year to business houses and $36 to residences, while the present rates in the new exchange are $24 to business houses and $18 to residences. So great a difference in rates was a great inducement to the subscribers and the number, it is expected, will increase rapidly and thus add to the advantages of the system. The proprietors, after the preliminary matters in connection with the exchange had been settled, received a number of offers from companies manufacturing telephones. To decide the matter the various instruments were tried with the result that the instruments and exchange system of the Western Telephone Construction Company of Chicago were adopted.

This telephone, which is an improved form of magneto telephone, is operated without the use of batteries and the expense of keeping them in repair is avoided. When once adjusted the instrument does not easily get out of order and being simple in construction it should last for years. The same method of magneto call bells is used as in old familiar types. The great reduction in price and low cost of maintenance will allow nearly everyone to have the advantages of a telephone.

The lines are run overhead in a substantial manner. The central office is located over the Central National Bank, and from this building the wires run to the various subscribers. The switchboard, which is one of the most important parts of the system, is most compactly arranged, and is very simple in operation. The accompanying engraving shows the style of the switchboard. It can be enlarged to any size desired by adding other panels. The operation is as follows: The call of the subscriber is indicated to the operator by the appearance of the drop with the number in view. The same movement by the operator that places the plug in the jack restores the drop. The subscribers are quickly answered and connected, and when the conversation is ended the subscriber indicates the fact by a "ring off." "Central" during the day is in charge of Miss Albaugh, and at night of Mr. Samuel Long.

The lines were constructed, and all work connected with the system, except the connecting up of the switchboard and instruments, which was done by Paul D. Myers, an expert sent out by the manufacturers, was done by the owners. The cost of operating a system is in this exchange reduced to a minimum. The instruments and the switchboard require but little attention, the aim of the manufacturers to produce a thoroughly substantial set of instruments having been accomplished. The complication of a large number of parts in any mechanism makes its maintenance a difficult and expensive matter. In this respect simplicity has been secured, but not at the expense of efficiency.

Exchanges of this size are found in nearly every state of the union, and the number is rapidly increasing. Experience has now shown their practicability and usefulness, and the reliability of the new manufacturing company has been established. The instruments and switchboard of this exchange were all manufactured at the factory of the Western Telephone Construction Company at Chicago.

The experiments and observations on the electricity of waterfalls, of Mr. Lenard, have attracted some attention. He has observed the waterfalls and surrounding air in the Alps and made many experiments in his laboratory. From the knowledge gained from these sources he draws the following conclusions: That drops of water that fall upon the surface of water or upon a wet body become charged positively and the surrounding air leaving the place of fall charged negatively. A jet of water that resolves itself into drops is thus capable, in a closed room, of causing great enough differences of potential to produce sparks. The least impurity of the water greatly lessens the effect.

Economy of Power House Operation.*

BY J. B. CRAVEN.

"Economy of Power House Operation" has been so often and so thoroughly discussed that I do not know that I can say much that is new on the subject, and yet being one that must ever come up before the management of a street railway system, I feel encouraged to beg the attention of this meeting for a few minutes, that we may see how and where with intelligent management and proper attention the best results may be obtained on the most economical basis. Starting from the boiler room, we come at once to the place where in most cases the greatest waste will be found. It has been said that the waste due to improper firing is often of greater consequence than any other loss which is produced in operating a steam plant. There are two causes for this. First, poor construction of the boiler; secondly, poor firing and lack of care of the boilers. Most of us think that any man can fire a boiler, and while looking with awe and wonder at the engine and generator, forget that all the power comes from the coal pile and pay little attention as to the economy in transmitting that power from the coal to the engine. No greater mistake is made than to place the care of boilers in incompetent hands, for they require the highest degree of care, conscientiousness and constant attention.

The fireman must be ever on the watch to see that the water is kept at the proper level, to keep an even steam pressure, and to show by his steam, coal and water records that he is getting just as good cards as the engineer can show by the manipulation of the steam be uses in his engine. He must see that the fires are spread evenly over the grates and are of an even thickness; that the proper amount of air is admitted into the furnace to obtain good combination.

If you could realize how earily from 1 to 20 per cent of coal can be shoveled into the furnace and up the chimney without generating any more power, you would see how essential it is to have something more than mere machines shoveling coal into a furnace. Another point of importance is to see that boilers are kept clean and free from scale, which is simply the result of improper attention.

If for a moment you will stop and think that in the construction of the boiler, the maker has reduced the thickness of the tubes as much as possible consistent with safety, and then look at a tube with from one-eight to one-half an inch of scale on it, you will at once see how great the loss must be transmitting the heat through this scale; not only that, but it leaves the iron exposed to the effects of the heat without the proper circulation of water back of it, which causes rapid deterioration, and in some cases is liable to cause an explosion. I have used quite a number of boiler compounds for the prevention of scale, but have found the best to be plain coal oil. We have used it in Buffalo for the past two years with success, putting about one pint a day into each boiler and letting it enter with the feedwater by means of a sight feed lubricator. However, no one remedy will fill all cases, and each must be the subject of some experiment.

Another source of loss comes from insufficiently covered boilers and pipes; see that all exposed parts, that possibly can be, are covered with some good non-conducting material, and prevent as much as possible radiation and condensation. The steam pipes should be kept tight and all leaks followed up at once and stopped, and in this way have as little loss as possible between the boilers and engines. See that the piping is well drained, so that water will not carry over to the cylinder of the engine. This is accomplished by separators placed as near to the engine as possible, and the water thus separated is returned to the boilers. In a good many cases this water is allowed to go to waste; if this is found to be the case it should be remedied, as this water is separated at a very high temperature, and requires very little heat to turn it again into steam. Before entering the engine room, I would like to say something on the subject of feedwater heaters. If your engines are running non-condensing, the question is very easily settled; as, however, the majority of steam plants are run condensing, other factors are brought in. In the power house of the Buffalo Railway company, one-seventh of the engine capacity is run high pressure. In this way, taking the feedwater from the hot well, at an initial temperature of 110 degrees, and passing it through two heaters in the exhaust line of the high pressure system, we get a final temperature of 194 degrees before the water enters the boilers. It is claimed by some that this method of taking the water from the hot well is not right, on account of the oil to be found in this water. But so small a portion of the hot well water is used, that the amount oil in it is small, and by this method we do away with secondary heaters in the exhaust line, between the engine and condenser, and not only save in the first cost, but I think obtain slightly better results. However, one thing is important, whatever means are used to heat the feedwater, it should be done, for not only will there be a great saving in fuel, but the straining of the boilers due to putting cold water in will be done away with

Passing from the boiler room, we come to the engines and generators, and the types seen here will be many and varied, from the high speed, belt-driven machine to the slow speed, direct-connected machine of large units. As you all know, the tendency of late has inclined to the use of the latter type. In my mind there is no doubt of the efficiency of the direct-connected unit over the belted one. It is evident to all that where space is valuable it has the advantage of taking up less room. They can be thrown in and out of service with as much rapidity as the belt-driven machine; there is a saving of from 1½ to 3 per cent due to the slipping of belts, very little in itself, but when figured up at the end of a year in a plant of any size it will amount to considerable.

Added to this there is the saving of labor and the decreased expense due to wear and tear, as this item is less in slow speed than high speed machinery. For the above reasons I have drawn the conclusion that direct-connected units are more economical than high speed ones. Regarding the size of units used, it depends entirely on the output of the plant. I would advocate as large as possible, yet not so large that the breaking down of one would cripple the output. However, in plants that have not these latest types of machines, great savings may be made in the operating of the engines. In many cases after the constructing engineer has left, engines are ofttimes supposed to look after themselves, those in charge simply supplying them with steam and oil. What I said in reference to the man in charge of the boiler room applies with equal force here. Put a thoroughly competent man in charge and you will find it a paying investment. Intelligence and experience are the best safeguards and the real insurance against accidents. Fifty dollars a month more to a capable engineer will probably be repaid a hundred times by the care taken and the high state of efficiency at which the machinery is kept. In such a state an engine is a reliable piece of mechanism. If neglected it is liable to fail at any time, causing delays and worries, and not only adding to the expense in the cost of repairs, but a loss in the receipts outside.

A capable engineer will see that his engines are indicated at least once a month, to see that the valves are properly set and so keep the steam consumption down to a minimum. All pounding, knocking and leaks should be followed up and remedied at once, and the engines kept in such a state as at all times to be ready to perform the severest service exacted from them. Always keep the load as near the normal capacity of the engines as possible, as engines at that point are most economical; besides, you will have fewer machines in service, and thus save in the oil supply. Here I will say a little on the subject of oil, as I think quite a saving may be made at this point; in fact, I have had one engineer use $640 worth of oil more in six months than another engineer used in the same time, and the engine capacity was increased during the time the last man was in charge. The lowest priced oil is not always the cheapest; some oils will go much further than others, and the question of what to use should be settled only by careful examination. After being used once it can be filtered and used again on the lighter parts of the machinery. If rags are used for wiping instead of waste, they can be washed and used again, and the grease and oil extracted will be found useful in some part of the system. By washing the rags 80 per cent can be saved over what the cost would be if only used once and thrown away. Coming to the generator, we find a machine that is usually well made and efficient. Keep it dry and thoroughly clean and have the commutator kept as smooth as possible. The principal trouble will be found in the sparking of the brushes and the heating of the armature and the field coils. The causes for these troubles are too many to enter into here; but on the appearance of trouble the machine should be stopped as soon as possible, for the old maxim, "A stitch in time saves nine," can be applied here. Keep the minor electrical apparatus in a station—everything such as switches, connections, and all instruments—clean and in working order, especially in the case of lightning arresters, as they may be the means of saving an armature.

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*Read at the twelfth annual meeting of the New York State Street Railway association, Syracuse, September 18, 1894.

In conclusion I would call your attention to the necessity of having ample copper in the outside lines, and the rails well bonded, and where the system is large enough put in return wires. What is the use of expensive and economical machinery in the power house if you allow 20 per cent of the power to be expended heating up poor connections in the return circuit?

Annual Meeting of The Canadian Electrical Association.

On Wednesday morning September 19, President J. J. Wright, of Toronto, called the Canadian Electrical Association to order in its annual convention, which proved to be most successful in every respect. The address of the president was attentively listened to. The report of the secretary and treasurer, Mr. C. H. Mortimer, for the year, showed a balance in the treasury of $273, the number of active members 99 and of associate 38. The address of welcome was made by Mr. J. J. York.

The first paper of the session was one by Mr. W. B. Shaw on "The Application of Electricity for Medical and Kindred Purposes from Light and Power Circuits." This paper reviewed the different uses to which electricity is put by the regular practitioner and also by the specialist. The methods of obtaining current was described and the advantages of special arranged systems. The paper on Electrolysis by Mr. James A. Baylis, contained a summary of the facts of the subject and the results of experiments and investigations as carried on by Prof. D. C. Jackson and others. It pointed out the remedies for the trouble caused by leakage of the current. It also cited cases where by the adoption of the remedies mentioned improvement was immediately noticed.

"Alternating Motors," were described in a paper by Mr. L. M. Pinolet. He entered into an explanation of the subject and described the construction of several types. On Thursday morning Mr. E. Carl Breithaupt read a paper on "Municipal Electric Lighting," which favored private ownership of lighting plants. Mr. D. H. Keeley placed before the convention, "A Method of Distribution, with Equalization of Potential Differences." For the method described Mr. Keeley claims a saving of 50 per cent in copper if used on the two wire system. The system involves two generators. The line from the positive terminal passes through the district supplied and returns to the positive terminal of the other generator. The negative poles are connected in a similar manner. The lamps are connected from the positive of one to the negative of the other.

Mr. John Langton read "A Note on Possible Reduction of Station Plant on Small Electric Railways by Multiple Series Control of Motors." The author shows that the maximum demand on the plant is reduced nearly one-third by the method described. Thus on small roads this means a reduction in size of plant but on large roads the difference would not be of sufficient importance to warrant attention. On Friday morning Mr. John Galt read a very interesting paper on "The Possibility of Securing Better Regulation at Central and Power Stations by Means of Fly Wheel Accumulators of Improved Construction." This paper was of considerable length and entered quite fully into the theory of the fly wheel. A new type of flywheel was described and illustrated by drawings. The subject was handled in an interesting manner.

"Cable Construction and Cable Faults," was the subject of a paper read by Mr. F. J. F. Schwartz. The value of the paper was greatly increased by the exhibition of a number of pieces of cable illustrating the facts mentioned in the paper. "Duplex Telephony," was described in a paper by Mr. T. R. Rosebrugh. The development of duplex telephony is very carefully described, the subject being taken up step by step and is very clearly worked out.

The social features of the convention were in no way neglected. The theater party through the courtesy of Mr. Paige, of the Packard Electric Company, the visit to McGill University under the guidance of Prof. Carus-Wilson, the excursion by invitation of The Montreal Park & Island Railway Company to Black River and the annual dinner of the association, were greatly enjoyed.

Obituary.

DODGE.

Wallace H. Dodge, of the Dodge Manufacturing Company, Mishawaka, Ind., died on September 10th. The company that bears his name, is widely known as a manufacturer of wood-split pulleys. He has been the leading spirit in this company, and has done much for the town where the works are located. Although but 45 years of age, he had attained success as a manufacturer. His death will be greatly regretted by the trade as well as by his numerous friends and acquaintances.

STEPHENSON.

William J. Stephenson, president of the Metropolitan Railway Company, of Washington, and vice-president of the American Street Railway Association, died at his home in Washington, on August 31st. He was but fifty-three years of age and up to two weeks previous to his death had been enjoying his usual health. The announcement of his death was a surprise to his many friends. Mr. Stephenson had for a long time been interested in street railway securities and had been very successful in the management of such properties.

VON HELMHOLTZ.

Baron Hermann Ludwig Ferdinand Von Helmholtz, the eminent German physiologist and physicist, died at Berlin, Germany, on September 8th from paralysis. He was one of the most distinguished men of his day. He visited America and the World's Fair last year and was the honorary president of the International Electrical Congress to which he was the Imperial German Delegate. At the close of the congress he was entertained as an honored guest in several of the eastern cities.

Born August 21st, 1821, he had therefore entered upon his seventy-fourth year. At the age of seventeen he entered the University of Berlin, from which he was graduated in 1842. The medical course he pursued at the university led him into the army, where he practiced several years as army surgeon. In 1845 he received an appointment as professor of anatomy at the Academy of Fine Arts. In 1855 he was made professor of anatomy and physiology in Bonn. His investigations and discoveries were published from time to time. The invention of the aphthalmoscope in 1851 attracted much attention. He was appointed professor of physics in the University of Berlin in 1871 and devoted much time to the study of electricity and kindred sciences. In 1887 the government founded a physical technical institution and over this new institution, Prof. Von Helmholtz was appointed to preside. In 1883 Helmholtz was honored by the German Emperor with a degree of hereditary nobility. Many medals and other marks of distinction have been awarded him by the scientific associations. He was the most noted discoverer in physical science.

Among no group of friends and admirers is his death more regretted than those of the United states. One of his sons is said to give promise of an intellect similar to that of his father and in that the world will rejoice.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.
Advertising Rates upon application.

The coming convention of the American Street Railway Association at Atlanta, Georgia, offers many inducements to those who will attend. The program prepared will cover whatever advancement has been made and the experiences of the members during the past year. While it will thus be a profitable trip, the stay in Atlanta, one of the pleasantest of southern cities, promises to be most enjoyable, and the trip through the south to the northern members will be full of interest. Indications point to a well-attended convention and the arrangements now in progress will provide every comfort and convenience during the journey.

Recent discoveries and inventions in connection with alternating currents and their adoption for power transmission, especially for the transmission of power from the great plant at Niagara Falls, has drawn the universal attention of the public as well as those connected with the industry to this most important subject. Numerous inquiries from our subscribers for information concerning alternating currents of electricity and for literature on that subject have led us to believe that a series of special articles on the alternating current from a practical standpoint would be highly appreciated by our readers. With a view to meeting what seems to be this popular demand, Prof. Geo. D. Shepardson, of the University of Minnesota, has consented to prepare such a series of articles, the first of which appears in this number of Electrical Industries. Prof. Shepardson is well known both in educational circles and among members of the electrical fraternity in this country, so that he scarcely needs an introduction to our readers. As Professor of Electrical Engineering he has taken a great interest in the practical side of the subject and his name has frequently appeared on the programs of electrical conventions. We known of no one more competent to write upon the subject than he. Electrical Industries has always sought to place before its readers articles that would be of the greatest interest and values and this series of articles will be followed by others similar in character on the most interesting and timely subjects connected with electricity.

A change of policy is noticeable, not only in the decisions of the courts respecting patents, but also in the actions of the patent office. This is due undoubtedly to the history of a number of patents which have been so general in character as to give to corporations complete monopolies of large industries for long periods, being able during the life of the patent to so thoroughly intrench themselves as to hold the field long after the patent had expired. The opinion of Judge Acheson on the "feeder and main" patent is decidedly against patents that are specified only in general terms. Regarding the claims of this patent he says: "The claims here, we think, were purposely framed broadly, so as to cover the simplest form of the alleged invention." It was the intention undoubtedly of the one who drew the specifications to make it cover as much ground as possible and thus secure to the owners a monopoly. But in endeavoring to cover so much exceeded the limits of a patentable invention. At the patent office applications are examined more critically and applications for patents on what shows an insignificant degree of invention are denied. While this policy will have a tendency to decrease the number of patents granted, many patents being denied as possessing insufficient merit, it is liberal enough so that worthy applicants will be given the protection a patent confers.

One of the acknowledged defects in the equipment of electric railways is the lack of sufficient and reliable means of stopping the cars. The hand brake filled its purpose on the horse cars and was in every way adequate to the service. However, on the swiftly moving electric cars a more powerful and reliable form of brake is necessary. On the steam roads the air brake was invented to meet the conditions of greater speed, but on the street cars making stops every few hundred feet the air brake adds to the equipment in weight, cost of repairs and expense of installation. The brake for electric cars should be low in first cost, simple in construction, easily and quickly operated and most of all should be reliable. A majority of the serious accidents which have occurred on electric roads have been due to defective or inadequate brakes. The expense that the damage account of many roads show, would warrant a large expenditure for an improved form of brake. The grades which the electric car readily ascends become dangerous when the car descends with the present form of brake. While the safety of the passenger depends upon the control the brake has over the speed of the car, the safety of the walking public depends upon the time and distance in which the car can be brought from full speed to a stop. The information contained in the paper by Mr. E. A. Sperry is an important addition to that previously possessed on this subject. In this paper the author is enabled, from his investigation of the subject, to point out the efficiency of the present form of brake and the defects of the method. The electric brake advocated has certainly many advantages. Some form of brake which will be on a par with the rest of the equipment of the electric car will undoubtedly before many years be adopted by the railways. The city governments are seeking to provide a remedy by passing laws limiting the speed of the cars but this does not get at the trouble and only defers the time when the adoption of a more suitable form of brake will have to be taken up.

The decision of the United States Circuit Court of Appeals, on September 12, which declared void the "feeder and main" patent, removes a claim that threatened a monopoly of the electrical field. The suit was instituted by the Edison Electric Light Company against Westinghouse, Church, Kerr & Co., for constructing and operating an electric lighting plant at Trenton, N. J. The decision of this court was in favor of the plaintiff. This decision, as will be noticed in another column, has now been reversed by the higher court. The suit was skillfully handled and an abundance of evidence was offered on both sides. The patent deals with the subject of electric pressure or tension in multiple arc systems of distribution, and purports to provide a remedy for the drop due to the resistance of the conductors. The claims of the patent said to be infringed describe a consumption circuit in which the drop is not sufficient to vary practically the candle-power of the lamps, in combination with a feeding circuit connecting the consumption circuit with the source of electric energy, the consumption circuit having translating devices and the feeding circuit no such devices. Testimony was offered tending to show that the principles were not new; that similar methods were involved in other systems of distribution, such as those of gas and water and that substantially the same arrangement was used previously to the application for this patent in the circuits for electroplating. Although these various points were covered with a voluminous amount of testimony, including numerous drawings and sketches, the opinion of the court dwells principally on the patentability of the so-called invention, and declares the first, second and third claims of the patent void. While this decision does not affect the value of patents in general, it does show a more generous policy—one that is not so favorable to the growth of monopolies and trusts. Had this patent been sustained this case would have been but the beginning of a series of litigation. Electrical patents have already furnished sufficient material for the courts. The scope of this patent may be inferred from the testimony of Professor Chandler, in which he says that a single house circuit supplying only a single house with current would be covered by the claims of this patent. A complete monopoly of the field would therefore have been granted to the owners.

THE competition of electric railways for local travel and even for journeys of considerable length is discussed in an editorial in a recent number of the Railway Age and Northwestern Railroader. Attention is called to the number of electric roads of considerable magnitude projected, such as from Philadelphia to New York, Philadelphia to Harrisburg, etc. Suburban electric lines connecting the different suburbs, and the suburbs with the business portions of our large cities, are in operation in nearly every one of our cities. These lines possess special advantages for this service and that they are appreciated by the public is shown by the abundant patronage. What the outcome of the longer lines will be cannot be determined until they have been tried. If they are to be competitors of the steam roads for long distances they will have to be constructed more on the lines of the steam roads, but for urban and suburban travel the electric road has found a field for which it is specially adapted and where there has been developed a prominent and permanent industry. The writer of the above mentioned article, says: "Thus far competition by means of these cheap and inadequate methods of carriage has been made extremely easy by the remarkable generosity of the communities traversed in giving up their wagon roads to tracks and horse terrifying motors of the electric road." Remarkable is not the word usually applied to the so-called generosity of a person, which permits him to give up something for an adequate return. The public has, in most instances, given the use of the highway, but in return has received the benefits of transportation at a low cost, a revenue in the shape of taxes on the capital invested and in some instances a percentage of the gross receipts. The electric railway is the people's carriage. The public gives up a part of its right to the highway so that it may have a common carriage for which a minimum fee is paid for the maintenance and operation of the system. These electric roads are able to cover a territory more thoroughly and provide a more adequate means of transportation for limited distances than the steam roads, which are greater in first cost and also in maintenance and operation. In this field they have encroached upon the traffic of the steam roads, to some extent, but this traffic is but a minor part of that of these roads. These roads have fostered certain classes which the steam roads never would have reached, encouraged to a greater extent suburban residence, and offered facilities of transportation unapproached by the steam lines. The competition of the electric lines has been successful on account of the unexcelled facilities it possesses for transportation over limited distances. The steam roads have watched the growth of these systems of electric lines with not the friendliest feeling and it is but natural that they should resent the encroachment. The position of the steam roads is illustrated in the following paragraph, which appeared in the above mentioned article, from the report of the New York, New Haven & Hartford R. R. Co.:

"The construction of electric railroads in the neighborhood of our property continues throughout all its territory. Wherever they seriously reduce the revenue of this property, we shall be compelled to lessen local service in a corresponding degree, as pointed out in our last annual report. The creation of level crossings of steam railroads by electric roads, whether by legislative or judicial permission, must lead to dreadful accidents. The people are calling for large expenditures by the steam railroads for the elimination of all grade crossings, and simultaneously their agents are increasing the danger to those which exist by allowing the electric roads to use them. Public sentiment sooner or later will condemn such inconsistency."

On October 1, Taylor, Dee & Mack, who have handled electrical supplies for something over a year, made an assignment to Franklin S. Terry. The statement made since the assignment shows liabilities $12,600 and assets $7,400. A committee was appointed at a meeting of the creditors to investigate the affairs of the firm.

The Westinghouse Electric and Manufacturing Company has brought suit against the General Electric Company for infringement of the Shallenburg converter patent, and asked for a referee to compute the profits and the damages resulting from the infringement of the patents. An injunction is also asked.

In all railway maintenance the preservation of the ties is a most important problem, as they are usually less easily replaced than on steam roads. Some reports on ties on one of the latter roads show that pine ties treated by the zinc tannin process had a longer life than oak ties, being credited with 12 years against nine years for the oak ties. The oak ties cost 78 cents delivered and the treated pine ties 72 cents. Other forms of treated ties have shown long average life on both surface and elevated roads.

The Postal Telegraph Company has been defeated in a suit brought by Mrs. Sullivan, of Hoboken, and damages awarded against the company of $150. It seems a son left home for the Catskills, and upon his arrival telegraphed his mother: "I arrived this morning. I shall write you Sunday." The message was delivered: "I arrived this evening. I shall want you Sunday." The mother believing the son ill set out immediately to join him. The trip cost her $90. The court held the company was negligent in employing inefficient servants.

The Annual Convention of The American Street Railway Association.

The coming convention of the American Street Railway Association at Atlanta, Ga., promises to be one of the most successful in its history. The opening session of the convention will be held at 10 A. M., on Wednesday, October 17. These sessions will be held in an auditorium in Machinery Hall at Piedmont Park, which will also contain the exhibits of the manufacturers and supply men. That this part of the program will fully equal that of any previous convention is assured by the demand for space in the building and the work that is already being done by exhibitors. The building will be supplied with power from the power house of the Atlanta Consolidated Street Railway Company. The park itself lies just outside the city limits but is easily reached by the street railway lines.

Among the subjects that will be discussed at this convention will be the following: "Can the T rail be Satisfactorily Used in Paved Streets?" "City and Suburban Electric Railways;" "Mail, Express and Freight Service on Street Railway Cars;" "Standards for Electric Street Railways;" "Street Car Wheels and Axles;" "The Best Method of Treating Accidents and Complaints;" "The T Rail Construction of the Terre Haute Street Railway Company" and "Transfers and Commutation." There will also be papers read on other subjects of interest.

The local committees which have the matter in charge have provided well for the social features of the convention. Wednesday evening there will be a reception at the Capital City Club; on Thursday evening the annual banquet of the association and on Friday there will be an excursion to Stone Mountain and a Georgia barbecue.

The headquarters of the association will be at the Aragon, which is a modern hotel but recently constructed. It is located on Peachtree street in the finest part of the city. It is magnificently furnished, conducted under an experienced management and is most complete in all its appointments. One of the oldest and best known hotels of the city is the Kimball House, which will probably be chosen by many attending the convention. It is located near the center of the city and is a large and commodious hotel. The rooms are well lighted and the diningrooms are pleasant and cheerful. There are other hotels with rates from two to four dollars, including the Markham House, Hotel Marion and National Hotel.

CHICAGO TO ATLANTA.

From Chicago to Atlanta are several lines, and delegates can take their choice of routes. The one, however, that seems most attractive, is that by which a special party will leave Chicago at 8:32 P. M., Monday the 15th, by the Monon route (the L. N. A. & C. R. R.) arriving in Atlanta the morning of the convention. This route will be most popular as there will be a special car reserved, and the party can stop over for several hours at Louisville, Mammoth Cave, or Nashville as they may prefer, without loss of time. Many will avail themselves of this opportunity to visit Mammoth Cave, special arrangements having been made so that delegates will have some five hours in which to view the wonders of this greatest of caves. By this route the party will take the Louisville & Nashville R. R. from Louisville, and from Nashville the Nashville, Chattanooga & St. Louis R. R. Returning the party will leave Atlanta reaching Chicago the next forenoon. This will give them the opportunity of returning by a different route from Nashville, over the Chicago & Eastern Illinois R. R., the line making the best time from Atlanta to Chicago, and enabling delegates to take in by daylight the finest scenery in the South as well as the scenes of many of the most important battles fought during the late civil war. Delegates should address the Monon Route for further particulars, 232 Clark street, Chicago.

Twelfth Annual Convention of the New York State Street Railway Association.

One of the best attended and most successfully conducted of the several state street railway conventions held during the past month was that of the New York State Street Railway Association, which met at "The Yates" Syracuse for its twelfth annual convention. The meeting opened Tuesday morning, September 18, with an address by Pres. D. B, Hasbrauck. He congratulated the association on the increased usefulness of the industry which it represented, and that although its revenue had been decreased by the condition of business it had not suffered in other ways

Electrolysis.*

BY JAS. A. BAYLIS.

"Electrolysis" has been announced as the subject of my paper, but it is too comprehensive a term to be applied to it, as it is to the electrolytic corrosion of underground pipes and electrical conductors by stray earth currents, that I wish to confine my remarks.

During the last year or two the attention of the electrical fraternity, and the public generally, has been frequently and forcibly directed to this subject, and several interesting and valuable articles and papers have appeared in the columns of the electrical press, or have been read before electrical societies. Up to the present time, however, no paper on this important matter has been presented to our association, and I believe that a thorough discussion of the subject at this meeting will be productive of much good to all interested; if my paper (for which I do not claim much originality) serves as a basis for such discussion, it will have well served its purpose. In preparing it, I have freely consulted the transactions of the various societies and the columns of the technical press, and must acknowledge the great aid they have been to me in so doing. This paper, therefore, is more of a resume of what has been done by others in this field, than the result of personal experience.

One of the first places to suffer from the evil effects of stray earth currents was Boston, Mass. Almost three years ago the New England Telephone and Telegraph Co. found that the insulation of some of their underground cables had broken down; upon investigating, it was discovered that the lead sheathing had been eaten through in spots in some of the manholes. The matter was carefully looked into, and it was proved beyond a doubt that the current from the rail side of the street railway circuit had leaked onto the sheathing of the cables at various points, and leaving the cables at others, had, at the points of leaving the lead, eaten it away to such an extent as to allow water to penetrate to the core, thus destroying the insulation of the wires.

It was soon found that the destruction of the telephone cables was but an item of the damage being done by these stray currents; water and gas pipes were being eaten through in a number of towns in which single trolley street railways were being operated. After careful experiment it was shown that only where the current left the pipes to pass to earth (i.e., where pipes were electro-positive to the earth) was any damage being done. The explanation given and the one generally accepted as correct was that electricity passing through a conducting liquid from the anode to the cathode, decomposes the liquid, and in the case of water, which contains enough foreign matter to make it a conductor, the hydrogen is carried, as it were, and liberated at the cathode, while the oxygen is set free at the anode, which, if it be of an easily oxidizable material, will soon be attacked, nascent oxygen being a very active agent.

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* Read before the Canadian Electrical Association, Montreal, September 19, 1894.

The truth of this has lately been questioned in a most interesting and valuable paper on this subject by Prof. D. C. Jackson, read before the Western Society of Engineers, July 11, '94. After a series of careful experiments, Prof. Jackson came to the conclusion that the oxydation of the metal as before mentioned, played an unimportant part in the destruction of the pipes, and that the corrosive action was due entirely to the electrolysis of the substances held in solution in the water of the soils. The gravity of the corrosion of the pipe depends on the amount of current flowing from a given area, and the nature of the salts in the soil. What happens in the case of buried pipes is this: The current which has leaked from the rails passes on to the pipes, and will leave them and flow to earth at points from which the resistance of the earth circuit to the power house is less than by the metallic one. The soil of cities contains more or less moisture holding in solution chemicals, which, when their components are set free, are of a more or less corrosive nature.

To decompose acidulated water between two platinum electrodes an E. M. F. of about 1.5 volts is necessary; with lead plates a smaller voltage; and with iron and zinc still less, as the affinity of the metals enters into the reaction. Metals buried in moist earth containing impurities may be about at the point of corrosion, a very slight potential difference being enough to set up marked action. This accounts for the destruction of pipes where only a fraction of a volt P. D. was found between them and the surrounding earth; because the P. D. is under one volt is no surety that action will not take place, not so rapidly or violently of course, but just as surely.

What forces the current to leave the rails and pass to the earth? Undoubtedly because of the too high resistance of the rail circuit, due to imperfect bonding; either the bonds are too small, or, what is more likely, the contacts between the rails and the bonds are not good. Sometimes the rails are connected to the water pipes of a town; if this is done care must be taken to have the water mains connected to the dynamo at the power house, otherwise if the negative pole of the dynamo be grounded or connected to the track, a path of low resistance has been provided for the current to get on to the pipes, but to return to the dynamo it must pass through the earth, and damage is sure to follow.

Very many remedies have been suggested and tried. Here are some of them:

1st. Grounding the positive pole of the dynamo and putting the negative to line.

This only has the effect of changing the location of the district in which the pipes are positive to the earth from the immediate vicinity of the power house to more distant points, and while the action is not so violent, it is spread over a much larger area and the trouble is much more difficult to deal with.

2d. Breaking the metallic continuity of the pipes and cables has been suggested.

This is impracticable, of course, not only because of the enormous expense of changing all the pipes at present in the ground, but from the fact that current would leave one section of pipe, pass to earth, and back on to the next section.

3d. Frequent reversals of the polarity of the street railway currents.

This would only retard the action, not stop it altogether. Various other more or less impracticable remedies have been proposed, but it will be unnecessary to notice them.

The only sure cure for this trouble, as far as we know at present, is in the adoption of some other street railway system than that of the single trolley with tract return, such as a double trolley system, storage batteries, or alternating currents, if a practical motor can be constructed. A method of street railway construction was described by Mr. W. Nelson Smith in the Street Railway Gazette of February 17, '94, which does away with the track return, being practically a double trolley road, operated under the three wire system, using the earth and rails as a neutral. Another system was described by Mr. Nelson W. Perry in the Engineering Magazine for March, '94. Many, if not all, of the proposed underground conduit systems would have as an additional recommendation, freedom from attendant electrolytic effects.

The discussion of the merits or demerits of these various systems, their practicability or impracticability, is outside the province of this paper; suffice it to say, that there seems to be more than one way of operating street cars, without destroying pipes, etc., already under ground.

Nevertheless, the fact remains, that there are very many single trolley roads in operation in this country, and that something should be done to protect the pipes of the municipalities under whose franchises the street railway companies operate.

Absolute protection, as far as is known, it is impossible to have, but to ensure the greatest freedom from destructive action, the track circuit must be of the lowest possible resistance. This can only be accomplished by the best of bonding and frequent cross connections of rails. Electrically welded rails should be of great service in this connection. The rail circuit should be reinforced by overhead returns connected to the rails at intervals, as is done with the trolley and feeder wires. The negative pole of the dynamo should be grounded, and the various systems of underground pipes connected to it by conductors of large carrying capacity.

These are the principal safeguards that can be adopted.

The telephone companies having underground wires have been among the sufferers from the electrolytic corrosion of the lead of their cables, and a brief description of the method used in the United States for their protection may be of interest.

A map of the underground conduits and manholes is made, and on it are marked the differences of potential between the cables in the manholes and the earth, also the direction of the current, whether to or from the cables. In this way the "danger district," or section where the cables are positive to the earth, may be seen at a glance. In this district, the sheathings of the cables are carefully connected together by large wire, and a heavy wire (or wires) is run from the negative pole of the dynamo, which is to ground, to the nearest manhole in the danger district, and if the current is of great volume, to several of the manholes. As far as I know, in every case, this has changed the direction of the current, causing it to flow from the earth to the cables, thus giving adequate protection in an inexpensive way. Unfortunately all pipes cannot be protected to the same extent in the same way, and the responsibility of doing proper track construction rests with the street railway companies.

Finally, because in a town there may be but small differences of potential between pipes and the surrounding earth, and decomposition of them does not set in as soon as the street railway current is turned on, we should not be deceived into a feeling of false security, for though the destructive action may be slow in coming, come it will, none the less surely.

The Chicago Rawhide Manufacturing Company, Chicago, has the proud distinction of having furnished the two bell cords to be used in ringing the Liberty Bell in its trip around the world. The history of this bell is familiar to nearly all Americans. Two bell cords are required. One is designed for special occasions and is composed of contributions from nearly every nation on the face of the earth, the center of the cord being made of rawhide. The other cord furnished by the company is for ringing the bell on all ordinary occasions. These cords, together with the hammer, were presented to the Liberty Bell committee by the Rawhide company on behalf of the people of the United States. The central part of the hammer is made of rawhide with steel flanges covered with brass work, engraved on one side of which is "Rawhide prepared by the Chicago Rawhide Manufacturing Company," and on the other side of the engraved figure representing Chicago, "I Will," is engraved "Work done by Wm. Ganschow, Chicago, 1894."

Works of the Fort Wayne Electric Corporation.

In the production of apparatus of any kind one of the first and essential parts of the process is the design. Upon this depends the excellence of the product. From a poor design no one can construct an efficient and durable machine, but from a good design, well worked out as to details, the skilled mechanic is able to turn out machines of a high order. Probably no class of apparatus requires as careful computations as electrical apparatus nor the accurate and thorough work of the skilled mechanic. In machines of this class the material used must not only pass the usual tests for strength and durability, but in addition must pass a certain standard as to its magnetic and electric qualities. On this account a well equipped laboratory is a necessary part of the engineering department.

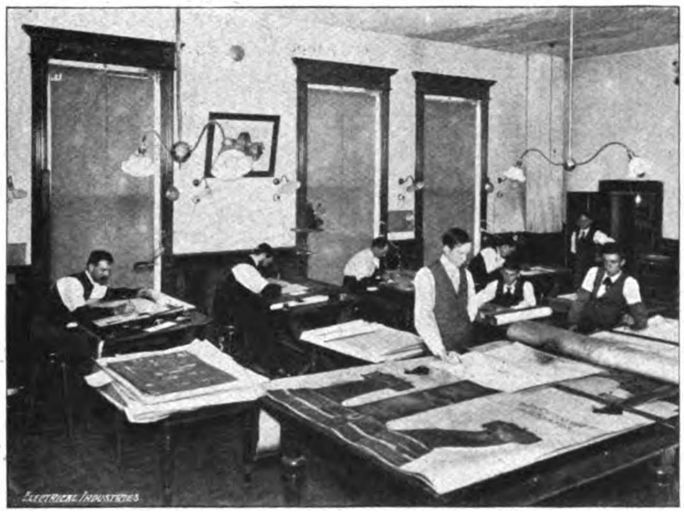

FIG. 1.—WORKS OF THE FORT WAYNE ELECTRIC CORPORATION.

In a visit to the works of the Fort Wayne Electric Corporation, the designing room, the laboratory and testing rooms are special points of interest. The excellence of the apparatus of this corporation is due undoubtedly to its engineers and the equipment of this department. Everything has been provided that would add to the efficiency of the department. The Wood arc and alternating systems designed by Mr. James J. Wood are undoubtedly familiar to the reader. The alternator up to 6,000 lights capacity, the transformers and other parts of the lighting system, are some of the latest to which Mr. Woods has given attention.

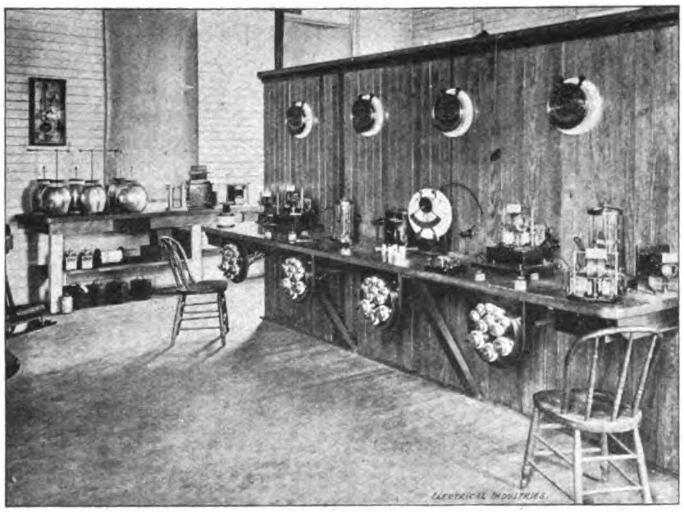

FIG. 2.—WORKS OF THE FORT WAYNE ELECTRIC CORPORATION.

The designing room is located over the main offices, and is light and airy. Nothing in the way of instruments and general facilities is denied the corps of draughtsmen. All dynamos are drawn in crayon full size and working drawings then made which are furnished the mechanics in the factory. For the laboratory a separate building was constructed and solid piers built up for the delicate instruments used. All vibrations due to the movement of the heavy machines in other parts of the works are avoided. A measurement is thus secured that can be used in calculations of the utmost exactness. Mr. Woods and his assistants have spared no pains to make this important feature a success. In Fig. 1 is shown the interior of the draughting room and in Fig. 2 is shown a corner in the laboratory where the Duncan meters are tested and calibrated.

For testing the different kinds of machines and apparatus separate rooms are provided. For testing arc lamps, which requires considerable space, ample room, current, etc., is provided. The arc dynamos are also carefully tested and inspected in the same building with the arc lamps. On the second floor of the factory is located the transformer, assembling, winding and testing departments.

The testing rack is so arranged that transformers of any size or voltage can be tested, from a 300 watt to a 25,000 watt, the iron non-inductive wire rheostat being located up in the roof away from all harm, and occupying no valuable space. On this floor a group of men are engaged in winding transformer coils, the turns necessary for each coil being automatically recorded on the dial of an instrument fitted to each lathe, and an alarm belt signals when the proper number of turns are on, making it unnecessary for the workman to stop and count. It also insures exact uniformity in all transformers, making it thus possible to bank any number, without fear of one or more not doing their right amount of work. This is a very important feature and it also insures absolutely correct and uniform service throughout the whole feeder system.

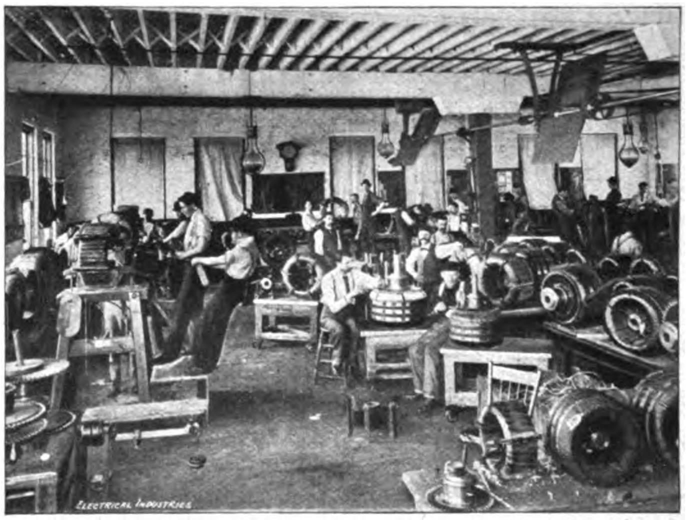

FIG. 3.—WORKS OF THE FORT WAYNE ELECTRIC CORPORATION.

The arc and generator armature winding rooms are also found on this floor, together with complete facilities for shellacing and varnishing wire, making of special insulating trough, paper, etc., as used in the iron-clad types of "Wood" generators. On the floor above is located the arc lamp and general instrument building rooms, in which all such apparatus, as switchboards, ground detectors, lightning arresters, rheostats, switches and the many and varied central station equipments are made and tested.

Mr. James J. Wood, the electrician and general superintendent, not only designs all dynamos, lamps, transformers, instruments, etc., himself, but personally looks to the matter of special tools and labor-saving contrivances for facilitating the manufacture of apparatus bearing his name. Indications of this special feature of Mr. Wood's inventive genius can be found cropping out on every hand. A trip through the Fort Wayne shops brings out to a marked degree the originality and freedom from repetition in machines and general appliances designed by Mr. Wood. The company is doing an immense arc and alternating incandescent lighting business now, and will shortly place on the market a line of multipolar generators for railway work, having many novel and valuable features embodied therein for this machine. A big sale may confidently be predicted. Among the new machines constructed is an alternator of 300 kilowatts capacity. This alternator has the largest capacity of any single armature compound wound alternator ever constructed in this country, having one-fifth larger capacity than the big alternators exhibited at the Columbian Exposition. The machine from the first has worked beautifully, and in every particular more than meeting the expectation of the designer, and so far as the workmanship is concerned, which is of the highest possible character, it reflects great credit upon the ability of the workmen who constructed it. The design is beautifully artistic, embodying neat lines and curves, while the efficiency is considerably over 90 per cent. Judging from the operation of this alternator during the test, the compan predict a great future for it, believing that no person could see it work without being favorably impressed by its operation. It is capable of operating 6,000 16 candle-power lights, and some idea of its size will be realized from the following dimensions:

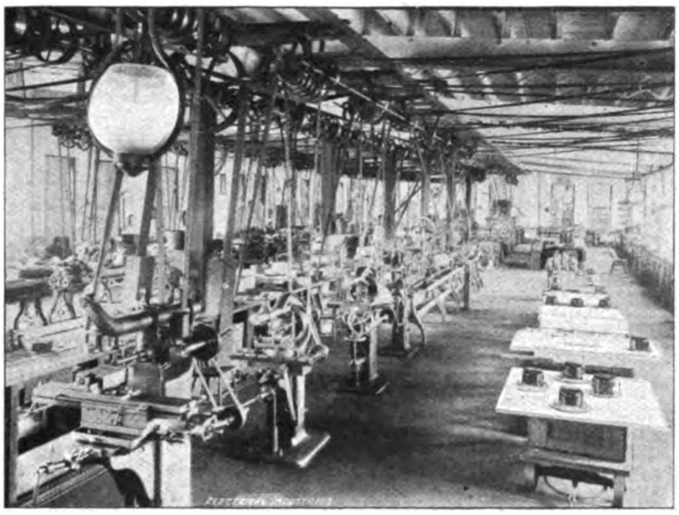

FIG. 4.—WORKS OF THE FORT WAYNE ELECTRIC CORPORATION.

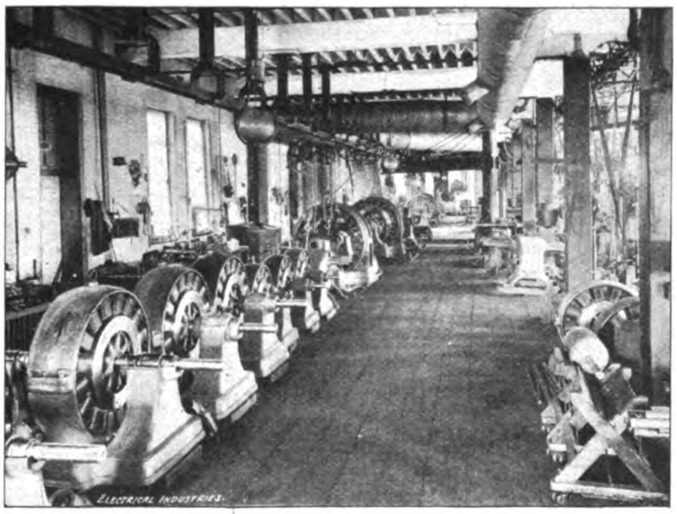

FIG. 5.—WORKS OF THE FORT WAYNE ELECTRIC CORPORATION.

It is 16 feet long, 8 feet wide and 10 feet high, while it weighs 31,000 pounds, producing a current of 150 amperes at 2,200 volts, requiring an engine of 600 horse-power to drive it. Another dynamo worthy of mention is the 125 light arc, which has attracted considerable attention. This machine is shown in Fig. 7.

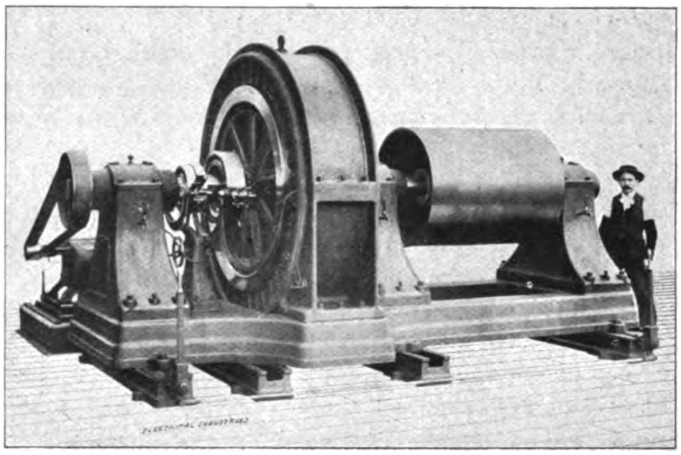

FIG. 6—WORKS OF THE FORT WAYNE ELECTRIC CORPORATION—A 300 KILOWATT ALTERNATOR.

The works of the Fort Wayne Electric Corporation are located on the line of the Pittsburg, Fort Wayne & Chicago railroad. The buildings number 12, and contain the most modern machines and appliances for the construction of electrical apparatus. The workmen employed are of more than ordinary intelligence, and the methods pursued in this factory are such as to enable the company to manufacture economically its well-known machines. Offices located in nearly all the large cities give this corporation direct communication with its customers.

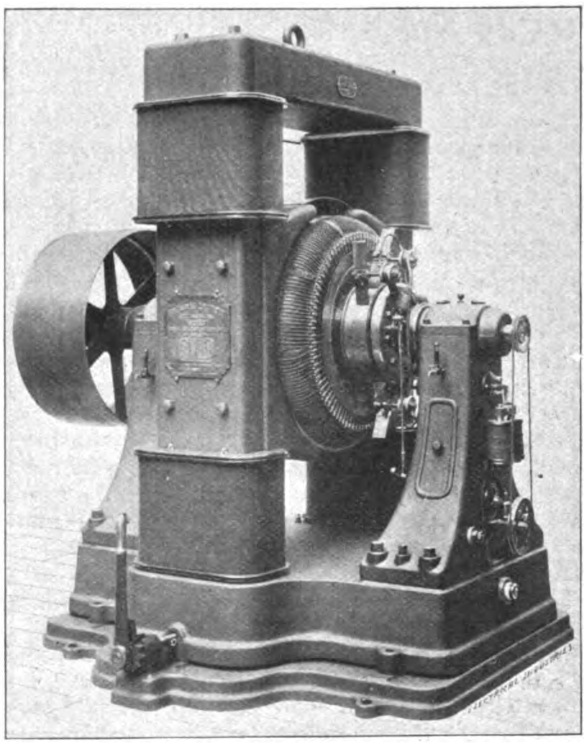

FIG. 7.—WORKS OF THE FORT WAYNE ELECTRIC CORPORATION—A 125-LIGHT ARC DYNAMO.

Even this short sketch would be incomplete without mention of some of the men by whom the affairs of this corporation are directed. Mr. R. T. McDonald has been connected with the manufacture of electrical apparatus since almost the beginning of the industry; an old resident of Fort Wayne, he has taken an active interest in the development of its manufacturing interests, and has been the active spirit in the companies out of which the present large corporation has grown, as he has been in this. He is known to nearly every one connected with the industry. In the management of the affairs he is ably assisted by Mr. C. S. Knight, who has also long been identified with the manufacture of Fort Wayne electrical apparatus. Mr. Knight has charge of the manufacturing as well as the sales department.

The engineering department is under the direction of Mr. F. S. Hunting, whose preparation for the work began with a thorough course at the Worcester Polytechnic Institute, which has been supplemented by a number of years of practical experience. Mr. James J. Wood is assisted in his experimental work and the designing of windings of motors and generators by Mr. A. L. Hadley, who has had a thorough and practical training in this branch of the work. The meter and instrument calibrating and testing department is in charge of Mr. Thomas Duncan. The chief inspector of the works is Mr. E. A. Barnes, who has had a training under both English and American engineers. His connection with this department dates back some five years. The Fort Wayne Electric Corporation has certainly a most efficient corps of electricians, as the complete lines of lighting apparatus, both continuous and alternating current, shows. The range of sizes made by this corporation equals if it does not exceed that of any other manufacturer.

On Multiple Series Control of Motors on Small Electric Railways.*

BY JOHN LANGTON.

The only efficient method of controlling electric street cars is to vary the volts at the motors according to the speed required. The facilities for doing this with storage batteries, by means of grouping the batteries differently, is one of the strong points of battery traction. In a trolley or conduit system with constant line pressure the same thing is arrived at by grouping the motors in series or in multiple. With only two motors to deal with, as in an ordinary street car, this makes rather an abrupt stop, which is eased off to a more gradual change by slowing them down by a resistance in series, or speeding them up by cutting out part of the field winding or shunting it by a resistance. This method was used in the early days of electric railroads, but was abandoned, not because it failed to give the results expected, but because it introduced a new complication at a time when there were so many troubles with every thing, that simplification was the pressing need. These early difficulties having been surmounted, multiple series control has been successfully revived.

The figure usually accepted for traction on street railway tracks in average condition is 30 pounds pull on the drawbar per ton weight of car, moving on a straight and level track. To start the car from rest requires a much greater effort. Dynamometer experiments show a starting pull of from 90 pounds to 120 pounds per ton, equal to the traction needed for ascending grades of 3 to 4½ per cent.

When the car is started with the motors in parallel, controlled by the simple process of masting in a rheostat the volts that are not needed at the motor terminals to give the amperes that are required for the traction, the demand on the station for power is greater when the car is being started than at any other time of its run, except on roads with heavy grades. But putting the motors in series for starting greatly reduces the power required. The torque of the armature, which gives the traction, is a matter of amperes, and with the motors in series the same traction is obtained with one-half the current required when the motors are in parallel. The power consumption from start to finish is rather more than one-half, apparently because the accelerating force is more irregularly applied, so that it that it takes rather longer to get up to speed; or to put the same thing another way, in order to get up to speed in the same time, rather more than half the average amperes are needed for motors in series, as compared with motors in parallel. The actual figures seem to be about two-thirds the maximum power, and two-thirds the total power consumption, in starting and getting up to speed in the same length of time. This method of starting then takes a maximum current, which, if divided between the motors in parallel, would only give the traction needed for ascending grades of from 1 to 2 per cent, and, as almost every road has steeper grades than these, the heaviest power demand on the station comes, not from starting, but from moving up grade at full speed. But if we are content to go up such grades at a considerably reduced speed, we can get, as in starting, the necessary traction with half the amperes, by putting the motors in series. The motors are then working with good efficiency on half the line volts and running at about half speed. There is, of course, no saving in the total power consumption—the energy; the car takes half as much current, but also takes twice the time to cover the distance. But there is a great reduction in the maximum power required, which would be about the same on a 5 per cent grade with motors in series as on a 2 per cent grade with motors in parallel, or about the same as the maximum power required for starting with motors in series. The motors must carry the same current in either case and must therefore be the same size, but the maxium demand on the power station from any one car is reduced nearly one-half.

On large roads the principle of averages may be relied on to a great extent, and the station capacity per car may approximate the average power taken by the car, but on small roads it is in general only safe to provide a station capacity per car of very near the maximum car demand. On small roads, therefore, a reduction of the latter means a reduction in size of station plant. Even if the average demand on a large station were appreciably affected by multiple series control it could hardly be availed of. The most valuable reduction is that on grades which may last for some minutes whilst starting is a matter of a few seconds. But rapid transit is a principal reason of the existence of large electric roads and a prominent source of their income, and they cannot afford to go slowly up hill. For large roads the principal value of multiple series control is the ability to run slowly with good efficiency in crowded streets, and the saving of wear and tear on switch and rheostat at such times and at starting. On small roads with a few cars running on fifteen to twenty minutes' headway it is more a question of communication than of continuously rapid transit; and, as has been shown, by sacrificing speed up hill a substantial reduction in the first cost of power plant may be achieved, without any sacrifice of ability to run at high speed on the level and low grades. The horse power hours drawn from the station would be the same per car trip in either case, but by easing off the starting current and slowing up on grades, the power would be drawn more uniformly, with the tendency to reduce the variations of load on the steam engines. This should give better economy in steam consumption, but it is not at all probable that there would be any noticeable effect on the coal bill. The load diagram of the station would still be badly serrated but the peaks of the diagram would be of more uniform height, and the highest of them lower than with motors always in parallel.

There is nothing new in this paper, and the facts and conclusions seem fairly obvious, but these and similar simple engineering considerations are continually either not observed or not appreciated in projected works, with the result of paying an extravagant price for some quality which brings in an inadequate or no return.

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*Read before the Canadian Electrical Association, Montreal, Sept. 19, 1894.

Duncan Meter For Alternating Currents.

BY WM. S. RESOR, B.S.

One of the problems which has confronted electrical engineers, has been the invention of a commercial alternating current recording meter, which will record "all" loads correctly. The credit of having solved this problem must be given to Mr. Thomas Duncan, of the Fort Wayne Electric Corporation, Fort Wayne, Ind. In the early days of electric lighting it was customary to charge so much per lamp per week, month or year, because there were no practical recording meters. This was of course, most unsatisfactory both to supply companies and to consumers. A recording meter was the dream of both. Before long, various types of recording meters appeared, which recorded, it is true, but gave no satisfaction, for the greater part of them made electric light very cheap for the small consumers, and very expensive for the large, on account of the slow speed on a small number of lights, and the high speed on a large number. But each has in turn been succeeded by others, claimed to be better, and now the Duncan meter seems to have reached the end of the line, and combines the virtues of all, and, let us hope, the defects of none.

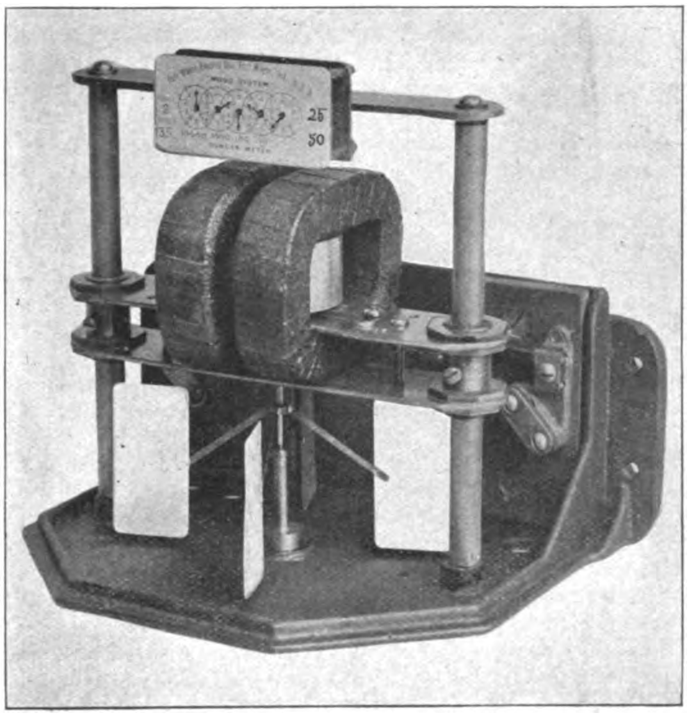


FIG. 1.—DUNCAN METER FOR ALTERNATING CURRENTS.

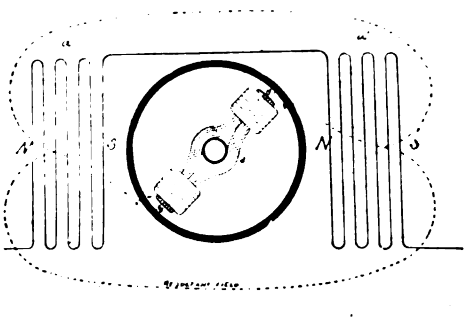


FIG. 3.

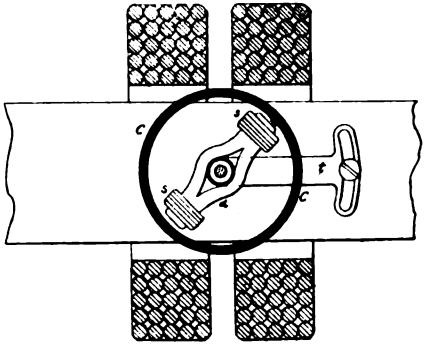


FIG. 2.

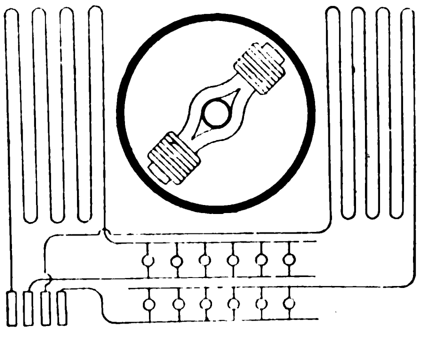


FIG. 4.

DUNCAN METER FOR ALTERNATING CURRENTS.

This meter is dependent on the principle of the repulsion of a closed secondary from its primary, and is a thoroughly practical and efficient development of Prof. Elihu Thomson's classical experiments on that principle. The essential parts of the meter are the primary or field coils a, a^1, (see Fig. 2) which are connected in series with the lamp circuit; the secondary or armature, C, consisting of an aluminum cylinder, a magnetic path diverter, D, made of laminated iron, and carrying a closed secondary, S, which consists of several copper punchings, the aluminum fans, the registering train, and the spindle which carries said armature and fans.

A very important feature of this meter is, that there are no brushes or commutator to get out of order, or other contacts to become dirty and oxidized. The armature has no electrical connection with the circuit. The motion of the armature or cylinder is due to the repulsion set up against it as a closed secondary, from the primary or field coils, a and a^1.

The action is explained more fully as follows: When the lamps are turned on the current flows through the coils, a and a^1, and an alternating field is set up. This field is distorted or diverted from its natural direction, along the axis of a and a^1, by the diverter, d, and assumes a form similar to that shown in Fig. 3. Faucault currents are generated in the armature and also in the closed secondary on the diverter.

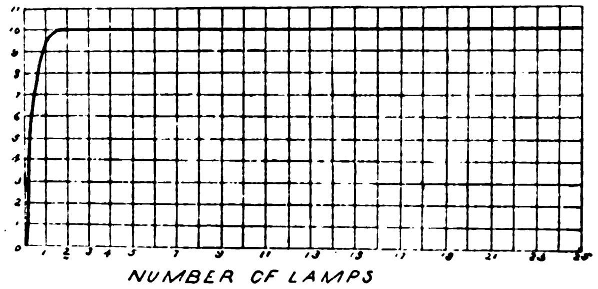


FIG. 5.—DUNCAN METER FOR ALTERNATING CURRENTS.

The use of this secondary on the diverter is to reverse its polarity. Suppose we consider the instant when the polarity of the primary or field coils, a and a^1, are as shown in fig. 3; the flux as it cuts through the cylinder obliquely, and as shown by the dotted line, will develop Faucault currents in it, which will have poles as shown in the diagram, i. e., a south pole on the outside circumference of the cylinder and facing the south pole, S, of the primary coil, a, thereby setting up a repulsion, due to their being of the same polarity. Again, the north pole, N, which is shown on the inner circumference of the cylinder will be attracted by the south pole, S, of the diverter, d. Therefore, the rotation is due to the repulsion set up by the two south poles on the outside of the cylinder, and the attraction between the two unlike poles inside. The same condition exists on the other or right hand side of the cylinder, only differing in the change of polarity.

The closed secondary which is divided into two, each half being placed upon the respective poles of the diverter, d, is for the purpose of changing the original or induced polarity of said diverter, so as to obtain a maximum torque in effecting an attraction between the induced poles on the inner surface of the cylinder and the diverter.

If the axis of the diverter be placed along the axis of the coils, a and a^1, or at right angles to it, there will be no motion, all the energy being expended in producing a lateral pressure on the shaft; but as soon as we move it from either of these positions, the force acts along a line which does not pass through the vertical axis, hence we have motion whose speed depends on the size of the angle formed by the two axis. Forty-five degrees gives the greatest speed. This meter is the only one upon the market whose speed curve is a straight line.

The speed on one light is a few per cent slow, on some as low as two per cent, but on all other loads the meter is correct.

NO. OF LAMPS.	REVS. MIN.	INITIAL SPEED.	PER CENT. ERROR.
1	9	9	10
2	20	10	0
5	50	10	0
10	100	10	0
15	150	10	0
20	200	10	0
25	250	10	0

Fig. 5 is an initial speed curve for a twenty-five light meter, and shows the remarkable constancy which the meter maintains throughout its entire range. Mr. Duncan has also applied this principal to meters for measuring and recording multiphase currents, and with particular success in the cases of two and three phase currents, also as a wattmeter for measuring the total energy. Fig. 4 shows a two phase meter and Fig. 6 a three phase.

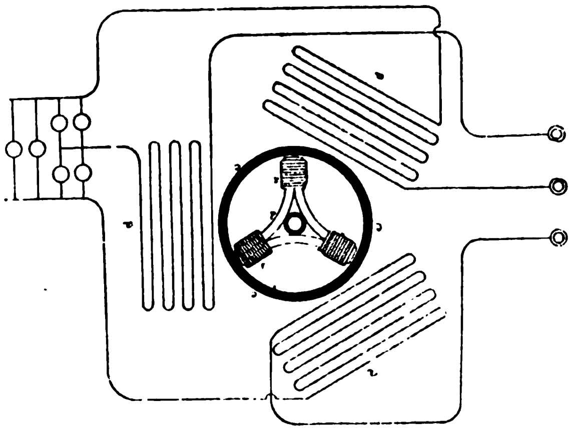


FIG. 6.—DUNCAN METER FOR ALTERNATING CURRENTS.

A striking peculiarity of the multiphase current meter is that it can be operated with single phase currents, by simply connecting its field coils in series or multiple arc, and in series with the lamps. Fig. 1 shows a complete meter.

A New Multipolar Dynamo.

SAMUEL E. HITT.

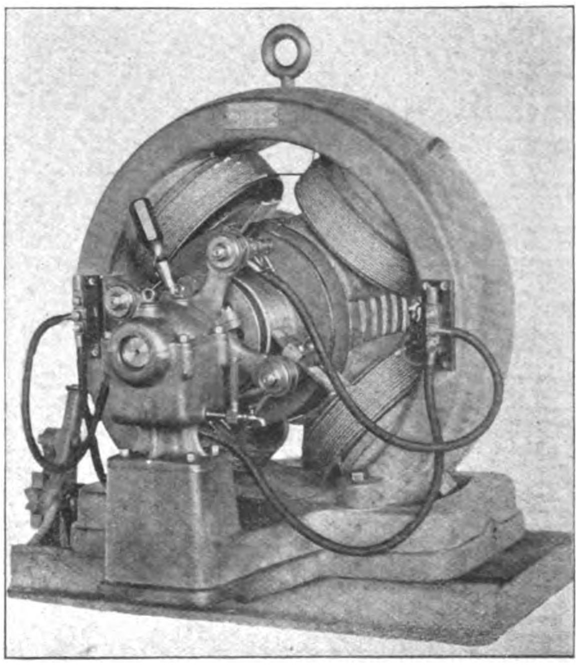
The accompanying cut shows a four-pole constant potential machine designed for Mr. Geo. A. Mayo, consulting engineer, Bryan Block, Chicago. The machine is placed upon the market by the Rockford Electric Mfg. Co., and judging from the number of orders received, promises to meet with favor.

Several features of novelty were embodied in the design that are unique and worthy of notice. In a few words the peculiarity of the design consists in the adoption of cast steel poles to a cast iron field. The machine is designed strictly from a manufacturers' standpoint. It is true that everybody is making multipolar dynamos and the general public prefer them for large sizes, knowing that the modern tendency and practice of engineers is in that direction. As a natural consequence, for the last few years manufacturers have gradually been replacing their bipolar machines, in the medium sizes, with machines of the multipolar type.

The result has been that there are now on the market many multipolar generators and motors that have neither the advantage of economy in manufacture to the producer, nor of slow speed with the attendant advantages in operation, to the purchaser. In the above design the intention was to make a light weight machine of slow speed and large cooling surfaces to prevent undue heating and to further reduce the losses by providing an extra large oil well in the self-oiling journal boxes.

However, the primary object kept constantly in view was to construct a machine on economical principles, with the purpose of reducing the shop labor to a minimum and of utilizing the material to the best advantage, getting the largest possible output for a given weight, and at the same time making no more use of expensive material than would be justified. Many of the above principles, as briefly outlined, are antagonistic to one another, and any design in dynamo electric machinery is of course at best a compromise.

Following this line of thought the machine was made with laminated ring armature as usual, with solid poles made in steel castings, and cast iron frame. These cast steel poles are made with the rectangular flange cast solid with the core, which is of circular cross section. This pole piece is secured to the cast iron frame by a large bolt and held in position with dowel pins. A cast steel ring was especially designed to carry the induction from the steel pole to the cast iron frame. Attention is drawn to the following advantages secured by this design.



A NEW MULTIPOLAR DYNAMO.

A low induction is secured in the air gap under the rectangular pole.

A high induction is used in the core under the field coil, which together with the fact that the section is circular, causes a saving of over 50 per cent in the weight of copper on the fields. By the use of a properly designed ring all the induction of the highly magnetized pole core is carried to the cast steel frame without loss by leakage. The field coils are removable and of circular form, saving much time and expense in shop labor. The smaller of the heavy castings, i. e., the pole pieces, are made in steel castings while the circular frame is one solid iron casting.

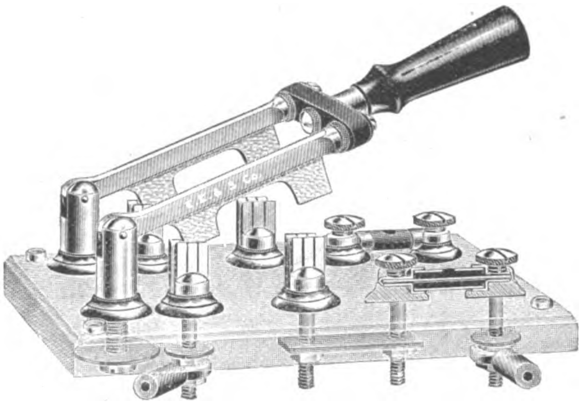
The section of the frame is so proportioned to cover the poles and coils, giving a neat and compact arrangement. To show how faithfully the principles above were applied, it is interesting to briefly consider the cast steel ring. For the sake of safety in this particular, the cast steel was assumed to have a permeability twice as great as that of cast iron. Without the ring, only half the induction could pass from the core to the frame, so the ring was made of such thickness that it was able to carry away at its contact with the core one half the total induction through the core. The area of a cylinder is $2 \pi r h$ and of a circle πr^2. Equating the two, it is readily seen that if the ring is of cast iron it would necessarily have a thickness of half the radius of the core and if made of cast steel it should have a thickness of one quarter the radius of the core. This is the way it was made.

The journal boxes are removable in order that the armature can readily be removed for inspection and repair or in case it is desired to remove one of the fields. The circular field frame is removable from its base to facilitate shipment in parts and a'so to make it easier to handle in the shop.

The machine is mounted on a sliding frame with ratchet and screw for belt tightening. The ball bearings are of solid bronze with self-oiling rings; the commutator is specially designed with many sections. Woven wire brushes bear upon the commutator at four points and leads of flexible cable are brought to the frame of the machine at each side. The above photograph is of the 25 K. W. size, of which several have been built. One of these machines under test gave 120 volts and 220 amperes at 700 revolutions. The field coils rose to a temperature of only 40 degress F., above the surrounding atmosphere.

New Knife-Blade Switch.

The manufacture of station switches has developed an art to which there seems to be no limit. The variety of styles and types placed on the market is necessitated by the different classes of work for which it is required. Improvements are constantly being made where increased use shows them desirable. The accompanying cut shows a switch which has a number of new features. It is manufactured by the Electrical Engineering & Supply Company, of Syracuse, N. Y. It is a combination of fuse block and switch. The connections are all made on the back of the board, which gives the face of the board a cleaner and more serviceable appearance. The switch is of a new style and has a trim appearance, but strong and of ample carrying capacity.

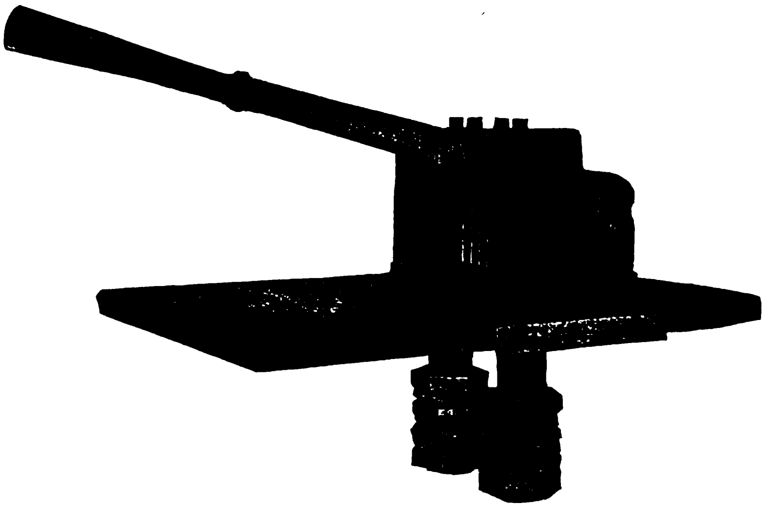


NEW KNIFE-BLADE SWITCH.

The fuses are surrounded by hard rubber tubes which protect not only the fuses from mechanical injury, but protects the board when a fuse is blown. There is a small hole in the tube to admit air. A metal cap is fitted over each end of the tubes. This cap is drawn out into a tube a little larger than the fuse wire. It thus holds the fuse wire and is inserted under the binding screw, which holds both securely. This combination is compactly arranged on the base and requires but a small amount of space. It is a convenient size for switchboards where space is limited. The connections being made on the back of the board only about one-half the usual amount of space on the board is needed. The metal used has been selected for its good conducting qualities and all parts are turned out by skilled workmen.

A Mammoth Ajax Switch.

The tendency of the present time is toward the consolidation of the smaller street railway lines, the construction of larger power stations and the installation of larger units. This is requiring the station appliances and instruments to be of corresponding larger size. It was but a few months ago that a switch which was guaranteed to successfully rupture a circuit carrying 3,000 amperes of current at a potential of 500 volts, was considered a giant in capacity. The Ajax switch built at that time demonstrated the utility of such large, quick-breaking switches and the ability to open a circuit carrying 2,000 horse-power without injury to operator or apparatus.



A MAMMOTH AJAX SWITCH.

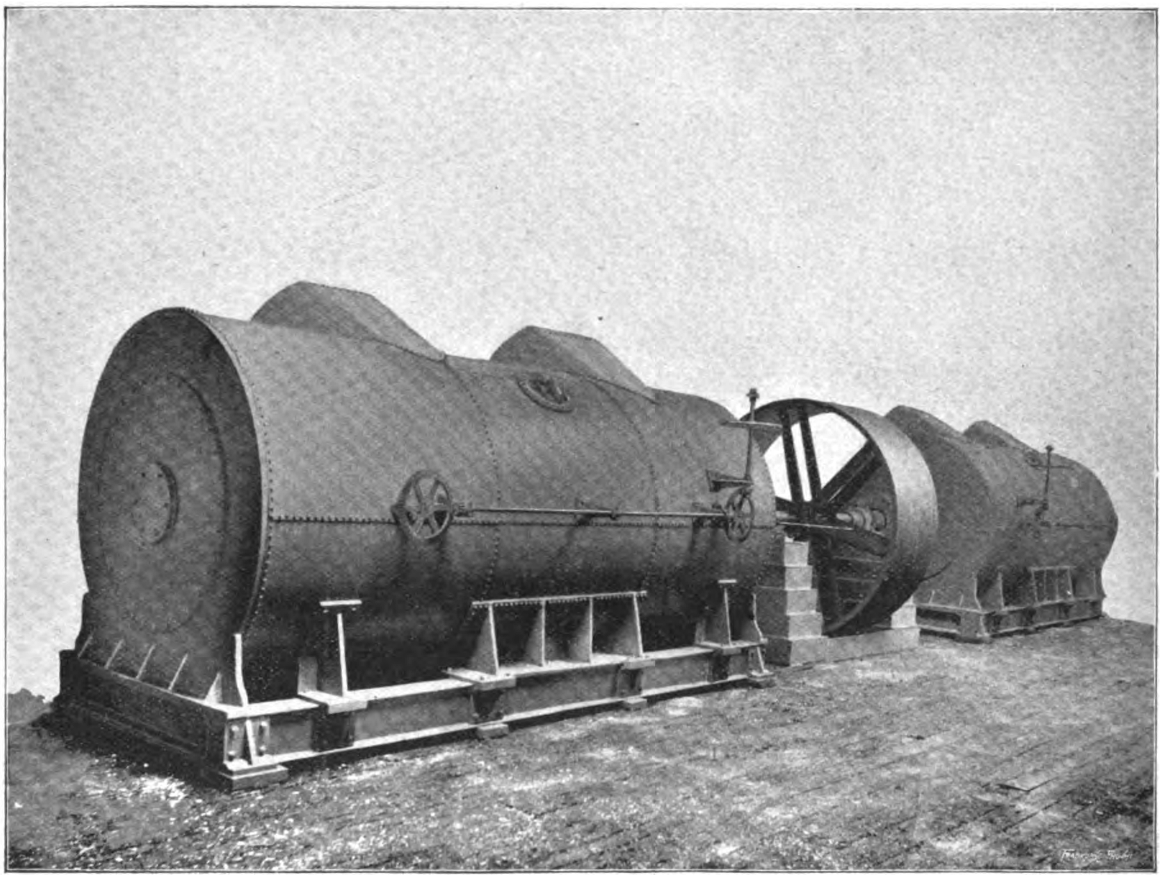
During the interim, Ajax switches have been designed for 4,500 amperes (fifty per cent larger than any attempted heretofore), and several such are in actual service on street railway circuits. We are now enabled to illustrate another advance in switches—the switch in the cut representing a new "plunger type" Ajax switch of 7,000 amperes capacity. This switch is guaranteed to break its full rated capacity at 500 volts potential, or nearly 4,700 horse-power. It was ordered by the Electric Traction Company of Philadelphia, through the General Electric Company, who are building the switch-board for their new Delaware avenue power house.

Except the carrier and stand, which do not form any part of the curcuit, the entire switch is made of commercially pure copper, and provision is made for clamping direct to a laminated "bus bar," consisting of six bars, each 5x¼ inches, or a total of 7½ inches sectional area, which is also the minimum of sectional area in any part of the switch. The contact area, finish and action are of the well known Ajax formula. The switch is compact in form and occupies a space only 14x13 inches on the switch-board.

A handle of unusual length is required to operate these large and close fitting blades, which overhangs the switch proper, several inches; the total length of the handle from the pivot is 41½ inches, and terminates in a highly polished piece of old mahogany. As a continuous current circuit breaker, it is believed the switch shown in the accompanying cut, is the largest yet attempted. It is needless to say that it has not yet been tested to its limit.

Woonsocket (R. I.) Electric Co.'s New Water Power Plant.

When the Woonsocket Electric Machine and Power Company purchased the Harris mill property on Main street, it was at once conceded to be a valuable addition to the company's holdings of real estate, as, aside from its value as a desirable piece of property, it could be utilized by the company in the extension of its electric plant, thus relieving the Front street station and concentrating its electric street railway plant in a location that would require less wire erection than would be the case if power was furnished from the Front street station, and the cost of wire is an item of considerable importance where much of it is stretched. The old apparatus used in utilizing the water power belonging to the estate has been replaced by new bulkhead gates, apron racks, and waste ways, and the installation of the powerful water wheels which illustrate this article. The old bulkhead gates and the attendant racks, etc., have disappeared, and in their place we find substantial hard pine framing and modern gates, 5½ inches in thickness, raised and lowered by an ingenious leverage arrangement requiring but little outlay of strength in the operation. The feeder tubes to the wheels are circular in form and come through the solid frame and plank to the gates themselves. From here the water passes through the feeder tubes to the turbines, on horizontal shaft, operating under seventeen feet working head and developing 600 horse power.



WOONSOCKET (R. I.) ELECTRIC CO.'S NEW WATER POWER PLANT.

Each pair of turbines is mounted in a separate wrought-iron flume, which rests on double steel I beams, which are supported at either end by the wheel pit walls.

The water is conveyed to these flumes, from the forebay outside of the building, by means of two wrought-iron feeder pipes which enter the flume nearly over each turbine. Each feeder pipe is supplied with a head gate, by which the water can be entirely shut out of the flumes in case it is found necessary to enter for examination or repairs. The flumes are also supplied with a cover at each end, which can be removed, leaving an opening large enough to remove any part of the turbines if it is ever necessary to do so from accident or other cause.

Each pair of turbines discharge into one draft tube, and with this arrangement, the two turbines discharging towards each other, no steps are required. When both turbines are running, as all the end thrust is balanced, but as the gates of these turbines are arranged so that one turbine of each pair, or one pair and one turbine of the other pair may be run, steps have been supplied.

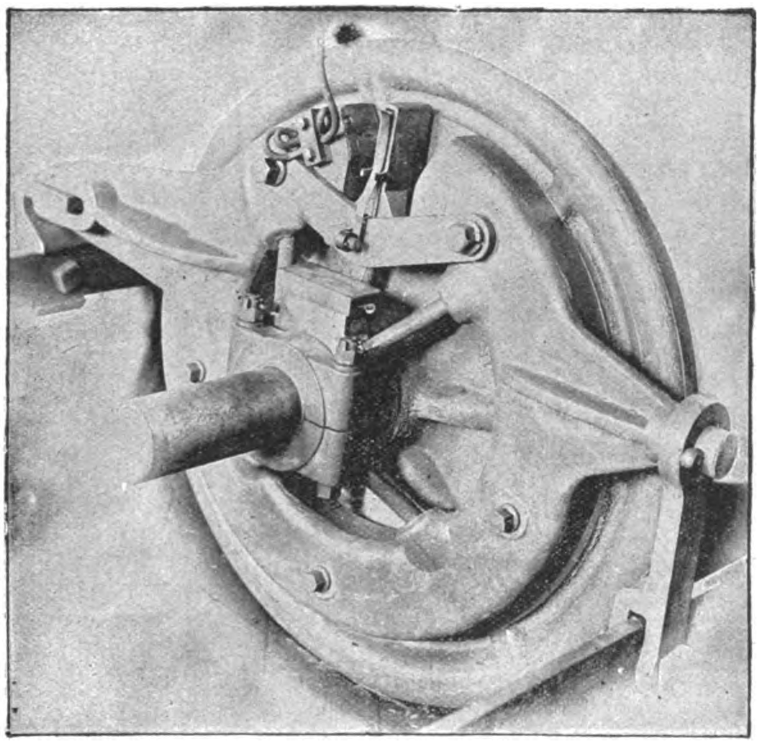
Each pair of turbines has a governor for regulating the speed. These governors and the hand wheels for operating the gates are located on the floor above the wheel room. Midway between the two flumes is the main driving pulley, which is 11 feet in diameter, with width of face sufficient for a belt 48 inches wide. The speed of the turbine shaft is 133 revolutions per minute, and with a pulley of above diameter, a belt speed of 4,595 feet per minute is obtained. This pulley is keyed to a steel shaft of 7⅜ inches in diameter, which runs in the latest pattern self-oiling swivel boxes. Connecting each end of the shaft which carries the large driving pulley with the shaft from each pair of turbines is a Worrell friction clutch coupling, so that the pulley may be driven with either or both pair of turbines. Throughout the entire power plant, while none of the good points that experience and mechanical skill could give have been omitted, simplicity and strength are prominent features, and the Woonsocket Electric Machine and Power Company, as well as the builders, the Stilwell-Bierce & Smith-Vaille Company, of Dayton, Ohio, are to be congratulated, for this is as perfect a water power plant as can be found in New England.

On the floor above the wheels, running parallel with the front of the building, is a heavy line of 6-inch shafting with a receiving pulley 51½ inches face, and 64 inches in diameter connected with the wheel shaft by a three-ply belt, 50 inches in width. To the left of the receiving pulley are three driving pulleys, each 69 inches in diameter, and 15½ inches face, each operated by a Worrell or Laconia friction clutch. These pulleys are for driving the power generators, which are connected by 15-inch three-ply belts.

These generators are installed on massive brick and stone foundations reaching to solid ground ten feet below the water line. To the right of the receiving pulley is another pulley, 69 inches in diameter, with a 15-inch face, operated, as are the others, by a Laconia clutch, which will be used to transmit power to the rooms above as they may be leased for manufacturing purposes. The three generators placed in this mill will be used in conjunction with another very powerful generator, to be located in the Front street station, to transmit the water power from this plant, when not in use, or only partially, to the Front street station, where it will be utilized, thus making a great saving of fuel over the present consumption.

The Sperry Electric Brake.

While advancement has been made in nearly every part of the street railway systems,the cars,as well as the methods of propulsion,improved, the manner of stopping the car has remained almost the same. Methods looking toward the improvement of this part of the equipment have from time to time been brought out, but although possessing some merit, none has up to the present time possessed the qualities that would permit its general adoption. An electric brake that gives promise of meeting the requirements of practical use, has recently been perfected by Mr. E. A. Sperry, of the Sperry Electric Railway Co., Cleveland, O.



THE SPERRY ELECTRIC BRAKE.

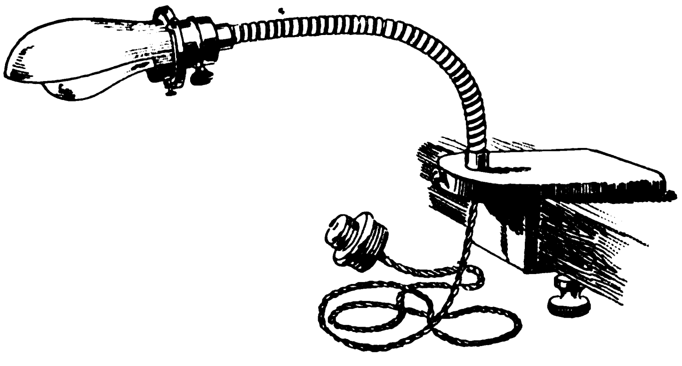
This brake is illustrated in the accompanying engraving, which shows the brake supported by the truck, and held close against the inner face of the wheel. While the faces are close together there is no mechanical wear, as they are well lubricated, and remain a perceptible distance apart. The horseshoe-shaped piece of metal presents a smooth, unbroken face, except at the top as shown. This opening permits the brake to be removed or put on at any time. This brake contains a single coil of wire, which is entirely enclosed and not liable to injury of any kind. The horseshoe or crescent shape has also upon trial been found the most advantageous form, as Faucault or eddy currents are largely gotten rid of. A lubricating device is placed in this opening.

The manner of operating this brake is one of its great advantages. The movements of the car are entirely controlled by one lever. A motorman will not need to be an athlete. In controlling the movement of the car the movement of the handle in one direction throws on the current, and in the other throws off the current from the trolley, and connects the circuit of the brake. The work of the motorman in operating the car will thus be greatly reduced, and he can give more attention to watching his track and waiting passengers. The motorman will be less apt to get confused, and cannot turn on the current until the brake is off. The rolling stock will not be abused as under present conditions.

Another point in favor of this brake is that no current from the power house is consumed in its operation. When the current from the trolley wire is cut off, the motor turned by the momentum of the car becomes a generator, and it is this current that is used in the brake. Thus, whether the trolley is on or off, the break is always ready for operation. Compressed air which is in general use on steam roads, is too cumbersome and complicated for the smaller street railways. The brake is said to be perfectly noiseless in operation, and does not cause a direct wear on the wheel or destruction of brake shoes. It operates smoothly, and is a modern invention.

Brakes of this kind were placed some time ago on the Chicago General Street Railway. There are in all some 150 equipments of this kind now in operation, which is sufficient evidence of the practicability of the brake.

Flexible Desk Bracket.



FLEXIBLE DESK BRACKET.

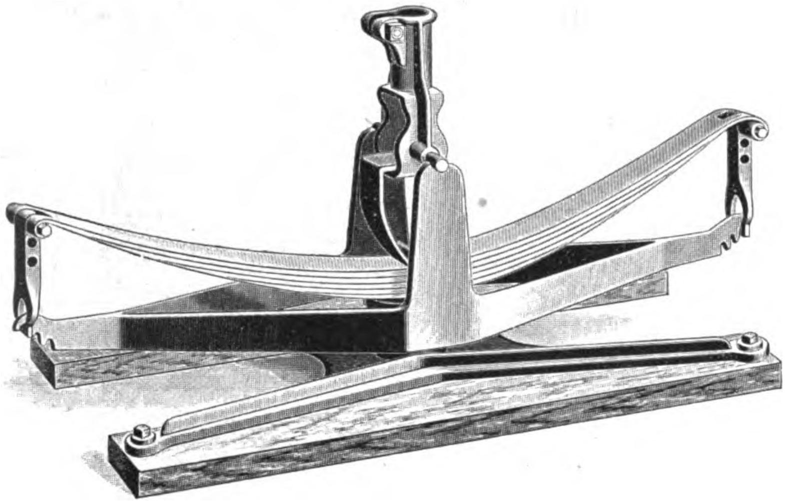
Ceiling or wall fixtures seldom throw sufficient light onto the modern office desk, and the heavy shadows and bright portions make evening work unpleasant with the ordinary fixtures. The advantages of the flexible bracket shown in the accompanying cut is at once apparent to all office men. It may be placed anywhere along the edge of the desk. The tube can be attached to the clamp in three positions, giving a still wider range to the lamp. The tube itself may be of any length, but the standard size is nine inches. Thus as the nature of the work changes, the position of the lamp may be changed to suit the convenience of the worker.

The light is always thrown directly on the work, and the eyes are relieved by the shade which throws the light from the eyes. Every part of the desk is well lighted, and the light can easily be shifted, when it is desired to search the drawers or lockers. This clamp and flexible arm is known as McCreary's Specialty No. 26. It is manufactured by A. A. McCreary, successor to the McCreary Electrical Specialty Company, 136 Liberty street, New York. The mention of the character of this specialty is unnecessary, as the McCreary specialties are well known to the trade. The experience of years in the manufacture of these goods is used in the production of each new specialty. The season is upon us when the days are short and artificial light is required. This device will be found most convenient.

The Ohio Trolley.

The Ohio Trolley, manufactured by the Ohio Brass Co., of Mansfield, Ohio, is one of the simplest and most effective on the market. It is made up of less than a dozen pieces, any of which can be easily duplicated. The spring is the regular flat leaf style, such as any manufacturer of carriage springs keeps in stock. The working parts of the trolley are made of steel, malleable and wrought iron and in consequence are not easily broken and do not get out of repair. The base and stand are three feet long and eight inches wide, and when the trolley pole is in a horizontal position but thirteen inches high. The trolley pole can be swung either forward or backward or in a complete circle, and the pressure against the trolley wire diminished as the pole assumes more nearly a horizontal position.

The trolley can be assembled or dismantled in a few minutes' time without the aid of tools. It is very easy and flexible in action, and will follow the variations of the trolley wire quickly and surely. In fitting these trolleys out complete, the Ohio Brass Company use the special carbonized steel trolley pole. This pole is drawn cold through a die and is made of the best Norway iron. It is then carbonized to the proper degree to give it sufficient elasticity. It is seamless and endless, and formed to a perfect taper. The claim made on this pole is that it is lighter, and more flexible and stronger than the regular style trolley pole. It will not break and if bent out of shape can be straightened cold without injury.



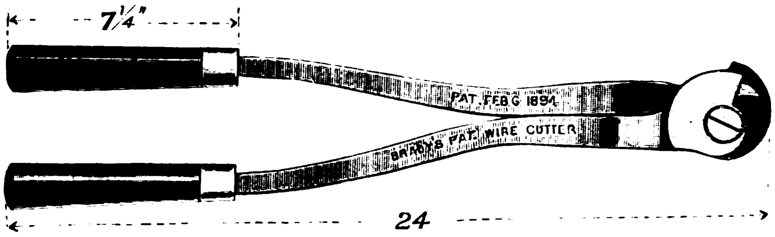
THE OHIO TROLLEY.

New Trolley Arm.

The United States Projectile Company of Brooklyn, N. Y., manufacturers of the patent hot-pressed motor pinion, which has met with success, have, after many experiments, perfected an improvement in trolley poles which materially reduces the weight as compared with the ordinary pole, and will give a stronger rod. The process is similar to that used by the company in manufacturing bicycle tubing, and the material is the same. The pole is started from a solid block of steel 3¾ inches in diameter and 7 inches long, and is gradually drawn out until it is the standard length, *i.e.*, 12 to 13 feet, and is then tapered, making a neat-looking pole. A fine grade of Swedish steel is employed, and the pole, by this process, is said to be 25 per cent lighter than the common one and stronger, which, by relieving much of the tension on the wire, will lengthen its life. About 200 of these poles have been used on the Brooklyn Heights Railroad during the last six months, and that company reports that only one of that number has been broken beyond repair. An average of from six to ten breakages of the common poles are reported daily on this road.

Safety Wire Cutter.

The accompanying cut shows a safety wire cutter, patented by Mr. J. H. Brady, of the Brady Manufacturing Company, 83 Washington street, Brooklyn, N. Y. The need of such a cutter has often been felt by all who have at any time been obliged to cut live wires. The dimensions and form of the cutter are shown in the cut. As will be noticed, the handles are of good length, giving sufficient leverage to cut easily any wire. The large insulated handles permit them to be used with perfect safety under all conditions. A simple piece of apparatus, it is well constructed and practically indestructible. The cutter is made of drop steel forgings with vulcanized fibre handles. The best tool steel is used, and being drop forged the result is the best cutting tool obtainable. The parts are made to standard patterns, and are interchangeable, making it possible to replace wornout parts. The blades are so constructed that, as they are ground away in sharpening, they can, by arrangements covered by the Brady patent, be set around notch at a time until the blade is entirely used up. If this should occur the blades can be replaced by new ones. Live wires can be cut with perfect safety with these cutters. This fact will make them of especial advantage not only to those connected directly with the industry, but also to firemen and others who have occasion to cut live wires.



SAFETY WIRE CUTTER.

The first all sub-marine cable from New York to Europe was brought into New York on September 2nd. The Commercial Cable Co., seeking to overcome the disadvantages of the shore lines of existing cables, determined to lay the new cable entirely under water. While the cable is not entirely free from injury on the bottom of New York Bay it is expected that the operation of the cable will be much improved. The large number of electric railways in Brooklyn has recently added another foe to the land connections, the heavy railway currents causing interruptions of the cable current. There is also the expense of constructing and keeping in repair the shore lines, which has not been a small item of expense. Sunday was selected for laying the final length of cable, since on that day the course of the steamer would be less impeded. The cable is about two inches in diameter, is composed of four cores solid No. 16 conductors, which are insulated with Siemens gutta percha. This insulation is covered with jute and No. 13 galvanized iron wire over which is laid in an opposite direction No. 0 galvanized iron wire. This cable was carried in the wells of the Mackey-Bennett and was paid out by the special machinery with which this steamer is equipped for cable laying. The entire cable was laid by this steamer except about four miles off Coney Island, which was laid by the tug "Stranahan." The shore portion of the work was superintended by Mr. Chas. Cuttriss, the electrician of the Commercial company. The end of the cable was brought to Pier A, where it was spliced to the shore cable which runs in underground ducts to the new Postal Telegraph building. The cable was laid at the rate of about five miles an hour.

New Vertical Engine of The Ball Engine Co.

In the design of this engine, the makers, taking advantage of their large experience of engine driving in electric stations, have tried to place themselves in the position of station owners and operators. It was desired to arrange an engine whose structure should be of such a form that the main pieces should be absolutely rigid and indestructible, while having this feature allow ease of access for adjustment or removal of any part that is subject to wear, and while covering these points to produce an engine whose steam distribution is symmetrical on both sides of all the pistons, whether one, two, three or four are used—in other words, an independent valve motion for each and every cylinder employed, and each of these being a perfect engine in itself.

By reference to the cut it will be seen that the main proposition as to strength and indestructibility is fully covered in the symmetrical form of the upright housings which are made to constitute one double housing by having one side of each planed and bolted together in the center of the middle shaft bearing. This substantiality is still further increased by the operation of planing the bottom of both housings to one continuous flat surface to meet the planed surface of the top of the single base plate to which the bottoms of the housings are substantially bolted.

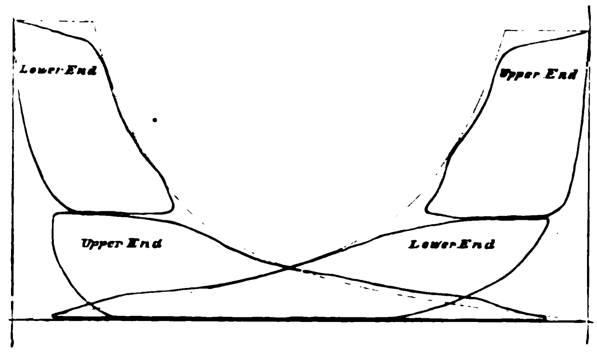


FIG. 1.—NEW VERTICAL ENGINE OF THE BALL ENGINE CO.

The introduction of the shaft into this engine is accomplished by arranging the shaft boxes in a large jaw cutting into one side of the housing deep enough to bring the center of the shaft in a plane with the center of the housing, finish spots being provided to meet correspondingly finished surfaces upon the cast iron boxes.

These boxes consist of one lower, two quarter and one top box for each journal, and these are provided with removable babbitt metal shells upon which the journals bear. These shaft box jaws are in turn closed by the use of heavy struts or plates having on their inner faces a V-shaped tongue on each end which fits into a corresponding groove planed on each side of the jaw. These struts are fitted so that when bolted in solidly by the four bolts in each, the jaw is closed and completes the symmetrical strength at the four corners of each housing, each strut being fitted so that there can be neither contraction nor extension of the outer end of the jaw.

Each housing is also pierced by a large rectangular opening on each side (shown covered by a door bolted on) as wide as the space between the inner edges of the struts and extending both high and low enough to allow the cranks with their counter-balancing discs to pass. Hence, with shaft, boxes and struts in place to close up the engine, it is only necessary to put up and secure large doors, which in turn are provided with a small shutter-plate covering an opening large enough for the insertion of one's hand to feel the connecting rod strap when engine is in motion, and the necessary wrenches to key up the crank boxes when so desired, while the adjustment of the journal boxes is accomplished by turning the three set screws shown in each strut, the two in the center reaching the quarter boxes, while the third one above operates either in or out a wedge which fills between the upper side of the jaw in housing and the top box; thus giving independent adjustment for three parts of each box while the lower box is perfectly free to move at right angles to the axis of shaft, thereby giving for all positions of adjustment of the quarter boxes a full bearing for the shaft.

The shaft is of one piece of forged steel from end to end, the crank pins being 180 degrees apart and cut out of the solid down to their round diameter, and as are the journals, ground to a perfectly round, smooth running surface. The connecting rods are of forged steel. The crossheads are of the double plate pocket type, as used in many makes of Corliss engines, are provided with taper shoes to compensate for any wear that may occur against the guides, the shoes being of cast iron with the running surface entirely covered with babbitt metal. The piston rods are of crucible steel, screwed into the crosshead. The pistons are of the double plate type, held up to a solid collar and taper by a well fitted nut. The cylinders are made of charcoal iron mixed in such proportion of hard and soft as to produce a very strong, close-grained iron which enables the surfaces to take a mirror polish. They are provided with single valves, each of which is practically one piece so far as the motion and wear are concerned.

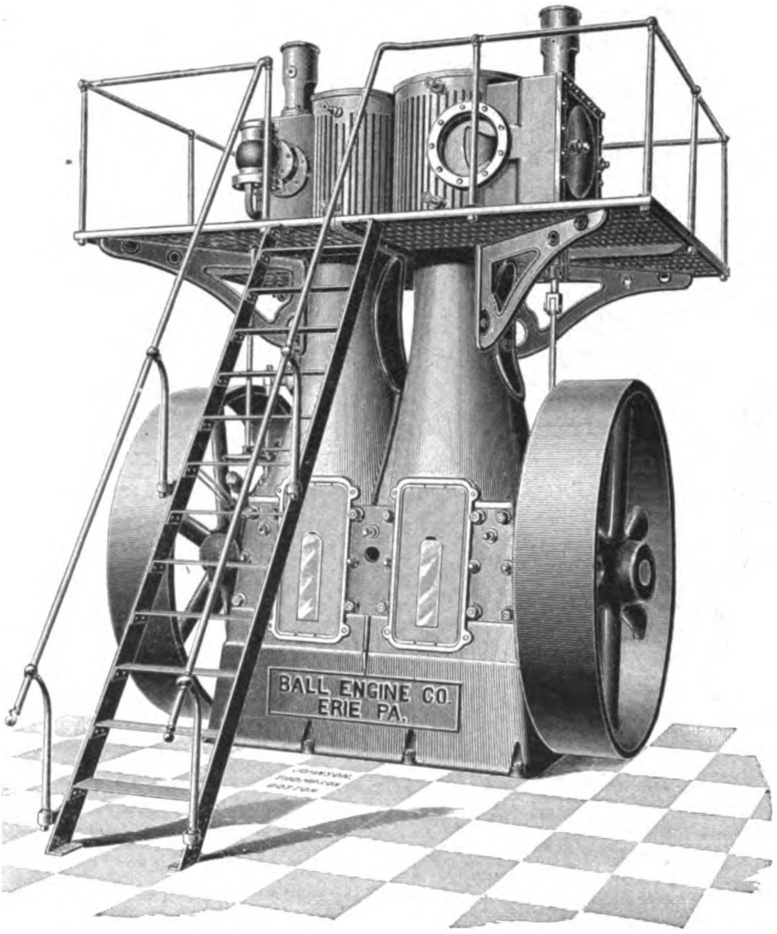


FIG. 2.—NEW VERTICAL ENGINE OF THE BALL ENGINE CO.

The high pressure valve is of the double faced telescopic relief type, with boiler pressure on the inside and sufficient amount of unbalanced area being left on the faces, that the force of the steam on the inside forces the two faces apart, causing each to rub against the seat with sufficient force to keep the surface polished and steam tight through the entire life of the engine.

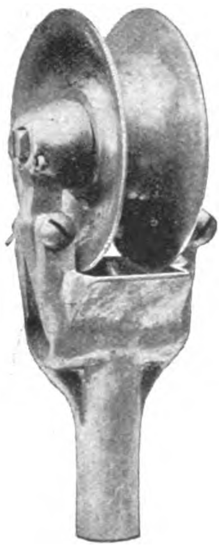
The low pressure valve is of the common letter D type with improved proportions and construction.

In substantiation of the main proportion contained in the production of this engine, there is presented an indicator diagram showing that where single valves of proper design are used the steam distribution can be made so perfect that it is simply folly to continue the chase after an ideal perfection that involves a vast amount of complication at an increase of first cost, maintenance and continuous attention, which is not justified by the results obtained.

This engine is guaranteed not to vary in speed from full load to no load, and vice versa, more than one per cent, hence, as the test showed, but .0086— eighty-six one hundredths of one per cent. It was conceded that the guarantee was fulfilled in very good form.

Falk Trolley Wheel.

The accompanying illustration gives an excellent view of the Falk trolley wheel and harp, which is being offered to street railway people by the Central Electric Company, Chicago. They consider this wheel a great improvement over other styles of trolleys using graphite or roller bearings. It is constructed with cone bearings, which are so arranged that they automatically compensate or adjust themselves to the slight wear. The wheel is at all times kept in a perfectly true position so that it never wobbles, runs unevenly or rattles. An important feature is the "dope" chamber inside the wheel, where a supply of lubricant is carried, sufficient for many miles of travel. No dripping of grease occurs. Everything is made of the best grade of steel, and all removable parts are secured by steel pins so that nothing can work loose or change its adjustment. A recessed collar, which is a part of the cone-holder, encircles the hub of the wheel, so that if a cone should break, a very unlikely happening, the wheel cannot fall out or become displaced. The harp is so patterned that should the wheel jump the wire it will not catch or engage the span wires. The Central Electric Company is carrying in stock a large and superior assortment of miscellaneous railway supplies. This company is making a specialty of a high grade of overhead material.



FALK TROLLEY WHEEL

Another specialty is the Chicago rail-bond. Thousands of those have been shipped to all parts of the country; they are conceded by users to be the simplest and surest bond yet offered.

Meeting of The American Electro-Therapeutic Association.

Many interesting papers were read before the American Electro-Therapeutic Association at its fourth annual convention in New York, September 25, 26 and 27. The program prepared was of considerable length and contained the names of the most prominent members of this branch of the profession. In connection with the meeting there was an extensive exhibition which attracted many visitors. The exhibitors, many of them, took pains to demonstrate some of the uses of the different apparatus.

The address of the president, Prof. W. J. Herdman of Ann Arbor, was the first on the program. The subject of this address was the "Function of the American Electro-Therapeutic Association." The names of many prominent electricians appeared on the program, including Elihu Thomson, Prof. Houston, A. E. Kennelly and others. Prof. Houston gave in a talk the features and results of numerous experiments on dogs made in conjunction with Mr. Kennelly. These studies were undertaken to test the assertions of D'Arsonval regarding the resuscitation of persons electrocuted.

The experimenters secured four dogs, upon which the alternating current was tried. Upon some a current of higher and others a lower number of alternations were employed but the effect was the same. It was impossible to revive the animals after having been subjected to the current. Experienced physicians applied every means of resuscitation, but the dogs were dead.

The members of the association were entertained by Nikola Tesla at his laboratory and many of his experiments were repeated.

Specialties of the Butler Manufacturing Co.

In the accompanying cuts are shown a few of the many arc lighting specialties manufactured by the Butler Manufacturing Co., of 46 South Clinton street, Chicago. The hanger board shown in Fig. 1 is designed to be used in connection with the company's arc lamp hood for suspending the arc lamp when it is not necesssary to disconnect it from the circuit. The board is made of well-seasoned hardwood, paraffined, and the hooks are strong and firmly secured to the board.

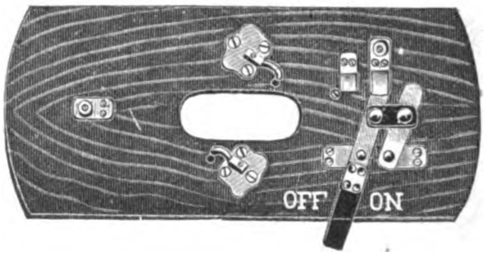
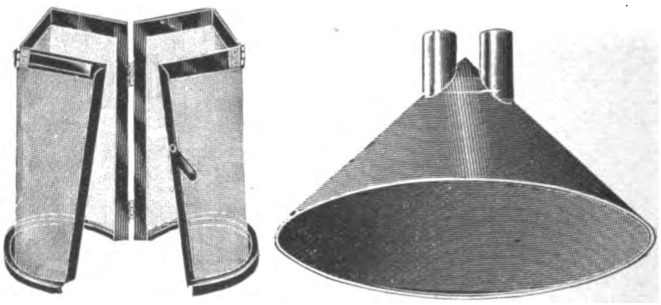


FIG. 1.—SPECIALTIES OF THE BUTLER MFG. CO.

In Fig. 2 is shown one of the several styles of spark arresters for arc lamps. This arrester is intended for angular lamps and is made in sizes to fit standard lamps. It is simple in construction and easily attached to lamp or removed. The weather protector shown in Fig. 3 is for double carbon lamps. The stem projects above the hood and prevents rain from reaching the top of lamp. The hood is held up from the wires and connections on top of lamp by the projection of the stem within the hood. It is made of heavy galvanized iron, painted white on the inside and black outside.



FIGS. 2 AND 3.—SPECIALTIES OF THE BUTLER MFG. CO.

The company is constantly adding to the list of supplies manufactured. New designs in reflectors and brackets for street cars are among the recent additions. Many orders are also filled for special apparatus from designs furnished by the railway engineers.

LEGAL NOTES.

ELECTRIC RAILWAY PATENTS.

In the case of the Adams Electric Company against the Lundell Railway Company, tried in the United States Circuit Court, a decision was rendered on September 17. The opinion was written by Judge Hallett. In the opinion the judge said: "None of the elements of the combination described in the claims was new at the date of the application; the motor and its several parts, the car axle, the axle boxes, the field supporting frame, and all other things mentioned in the claims were in use and before that time. The form of some of the elements was changed in the Adams combination, but it is clear that none of them was new at that time."

The claims made by the Adams company in the patent which was granted in 1884, cover in an electric motor the combination with the axle, which carries the driven wheels, the axle boxes or bearings, and a frame secured to or formed in one with a said boxes or bearings whose armature is mounted to revolve on said axle; also the driven wheels, their axle and axle bearings and supporting frame,together with other combinations set forth. The case was really defended by the General Electric Company, which furnished the equipment of this road.

STORAGE BATTERIES.

The motion for a preliminary injunction in the case of the Brush Electric Co. et al., *vs.* The Electric Storage Battery Co. et al., has been denied by Judge Green in the United States Circuit Court, District of New Jersey. The following is a brief abstract of the opinion:

"Two reasons conjointly compel a denial of the motion for a preliminary injunction made by the complainants. The validity of the letters patent in question is beyond dispute. They have been sustained by all the courts, before which they have been the subject of litigation. The only question to be considered upon this motion, under the circumstances, is that of infringement. * * * "Upon one side are found the concurring opinions of Prof. Morton and Prof. Chandler, Prof. Houston and Dr. Barker; upon the other, those of Prof. Brackett, Prof. Cross, Prof. Thomson and Mr. Van Size. These are gentlemen of unquestioned veracity; thoroughly understanding the subject matter under consideration; stating opinions with confidence which they believe to be well formed, and yet they arrive at conclusions which are irreconcilable and diametrically opposite. It must be apparent that affidavits of this character *ex parte* as they are, can only be productive of doubt. When the statements so made and the opinions so expressed come to be tested by a severe and thorough cross-examination, beyond question, those which show themselves securely founded upon reason and fact will be immediately accepted and concurred in. But until then the existence of a doubt, well founded and reasonable as to the right of the complainants to the remedy they ask, cannot be overlooked. The existance of such doubt must now at least control the action of the court. It is fatal to a motion for a preliminary injunction. To justify the interference of a Court of equity *pendente lite*, by way of an injunction, the actual or threatened infringement of a right must appear as clear as the noon-day sun.

"There is another reason why this motion must be denied. Equity demands of a complainant that he should display great diligence in the assertion and vindication of his rights. Inexcusable delay on his part, though it may not amount to conclusive proof of acquiesence, nevertheless may be, and often is, sufficient cause to disentitle him to the summary interference of the court on his behalf by way of interlocutory injunction. Whatever may be the original equities of the case, as between the parties, if the complainant stands quietly by, without seeking to enforce his rights, while the defendant expends time and labor and money upon the enterprise sought to be enjoined, upon faith that no actual or effective objection thereto will be made, he will be shorn of any right to appeal to a Court of Equity for assistance."

The opinion here reviews the history of the defendant company, its organization in 1888 for the sole purpose of manufacturing and selling storage batteries, the prosecution of this industry with the full knowledge of the complainant. The matter is more particularly brought to the attention of the complainants by a letter of July 1893 in which it is demanded that the matter be immediately brought before the courts. "To this letter the complainants returned no answer beyond a mere acknowledgement of receipt, and admittedly took no action toward the assertion of their claim until months after."

"If, in fact, the rights of the complainants have been invaded by the alleged infringing acts of the defendants it is scarcely an exaggeration to say that the dilatory conduct of the complainants, in protecting their rights, amounted to open encouragement of, or at least, to silent acquiesence in such invasion. Such conduct bars absolutely the remedy asked for, at this time, by the complainants.

"It was admitted upon the argument that the defendants were financially responsible, and amply able to respond to any award of damages that might be made against them. Under all the circumstances and for the reasons given the motion for a preliminary injunction is denied."

FEEDER AND MAIN PATENT NOT VALID.

On September 11 the decision of the Circuit Court of the United States for the district of New Jersey, in the case of Edison Electric Light Company against Westinghouse, Church, Kerr & Co., was reversed in the higher court, the United States Circuit Court of Appeals for the Third District, at Philadelphia, Judges Acheson, Dallas and Butler. The opinion was written by Judge Acheson, an abstract of which follows: "This suit was for the alleged infringement by the defendent of letters patent of the United States to Thomas A. Edison, No. 264,642, dated September 19, 1882, granted upon the application file of August 9, 1880, for an electric distribution and translation system." The specifications of the patent are reviewed and then the opinion continues: "For the proper determination of this case it is essential that the subject matter of these claims should be clearly understood. This patent does not deal with the complicated general problem of the distribution of electricity and the subdivision of the current for the purpose of domestic illumination. The patent is not for an incandescent lamp, or for a dynamo for generating electricity, or for the arrangement of lamps in multiple arc, or for indicating and regulating devices for controlling the current from a central station, single or combined. The patent deals with the one particular difficulty of drop in tension or fall of pressure, loss of electromotive force, due to the resistance of the conductors to electric flow. To remedy the evil effect therefrom, the patentee provides special conductors for the transmission of electricity extending from the generator to the main conductors, with which the lamps are connected and from which they are served. The patent is for a specific arrangement and proportioning of the two sets of conductors which together constitute the complete circuit.

"The claims with which we are concerned, as we have seen, are each for a combination of two elements, a consumption circuit and feeding conductors having respectively the peculiar properties specified. The primary question for solution then, is whether it involved invention in a patentable sense, to combine a circuit for feeding only with a consumption circuit, the main conductors of which are so proportion as to maintain such uniformity of pressure upon them that there is practicallly no variance in the candle power of the lamps connected therewith. Now a claim for a combination carries with it an implication that the separate elements are old. * * * In the present instance the positive proofs accord with the implication. Most certainly the patent in suit discloses no new means either for transmitting a current of electricity or for equalizing pressure upon the consumption circuit.

"It is to be noted that the patent leaves it altogether to the judgment of the electrical engineer or contractor to determine the relative lengths of the two parts of the combined circuit and the proper thickness of the conductors. As to these points no definite instructions are given.

"Of a truth the feeding conductors of the patent ar nothing more than the ordinary supply wires running from the source of the electrical energy." The judge points out that in the art of electroplating wires were so used before the filing of the application of this patent.

"Under the proofs we cannot assent to the suggestion that the alleged invention here in question supplied a long-felt want, or met a difficulty generally recognized in the art as a serious hindrance to the distribution of the electric current. In fact, prior to the application of this patent no incandescent electric lighting lamp had been furnished to the public. Hence engineers had not been called upon to deal practically with the problem of drop in tension in the construction of such plants. In truth, the feeder and main system of distribution came naturally in the ordinary progress the art of incandescent electrical lighting, as and when needed.

"The plan of electric distribution covered by the claims in question is not 'the creative work of that inventive faculty which it was the purpose of the constitution and patent laws to encourage and reward.' To sustain these claims would be to sanction a monopoly in that which belongs to the public.

"The decree of the court below is reversed and the cause is remanded, with directions to enter a decree dismissing the bill of complaint with costs."

A BRIEF REVIEW.

NICOLA TESLA AND HIS WORK.

Under this heading Mr. Nelson W. Perry has an article in the Engineering Magazine. He mentions many incidents of Tesla's life and, regarding his discoveries, says: "The one discovery of Mr. Tesla, which, among practical men, stands out most prominently today, because of the practical results already obtained, is his discovery of what is generally known as the rotating magnetic field.

"Mr. Tesla conceived an idea which has entirely overcome the shortcomings of an alternating current as applied to motors. Everyone knows, or at least is easy of demonstration, that if the north and south poles of a small horse shoe magnet be suspended over a bar of soft iron, free to revolve in a horizontal plane, or be placed over an ordinary compass needle, the latter will be attracted at either end by the poles of the magnet and take a position parallel to a straight line drawn between the two poles of the magnet. Now if the latter be revolved through any angle the soft iron or needle will follow, being dragged around by the magnet, and if the magnet be caused to revole regularly the iron will also revolve, being pulled around by the full force of the magnet. It is not feasible, however, to cause the magnet to revolve in this way, and Tesla's invention consisted in obviating this trouble and, in fact, in greatly simplifying the problem. He conceived the idea that if he took an iron ring and used two alternating currents, one of which had its maximum value at instant that the other had a zero value, or, in other words, two currents whose periods were such that one waned as the other increased, he could produce in that ring by winding these circuits in alternate coils surfaces that without any mechanical movement of the parts would travel around that ring with a rapidity equal to the number of changes of direction of the currents employed. He thus had a ring, the north and south poles of which were rapidly revolving just as would the poles of a horse shoe magnet were it tied at its middle to a twisted string and allowed to revolve. A piece of iron pivoted at its middle placed concentric with this ring would, therefore, be dragged around by the changing poles of the ring. He had thus discovered what is somewhat awkwardly expressed by the expression, 'the rotary magnetic field,' and also the use of what have been termed 'polyphase currents' the one referring to the magnetism and the other to the combination of currents by which this changing magnetism was produced. Thus discovery is undoubtedly one of the most important that has ever been made within the domain of alternating currents, and marks a most important step in applied electricity.

"Mr. Tesla early turned his attention to phenomena of alternating currents of high frequency and high potential. These brilliant effects, which have so much interested scientific men, are obtained in his experiments by a peculiar arrangement of condensers and coils which enables him to obtain enormous potentials of a million volts or more, which are alternating in direction many million times a second, if necessary. In the reports of his lectures his apparatus is minutely described, but limited space does not permit me to dwell upon it here." After describing some of the effects produced in the experiments with these currents, the author continues: "While none of these experiments on light have developed into practical processes, they constitute one of the most remarkable contributions to physical science since the days of Faraday. In the brilliancy of their conception and the beauty of the results obtained we are apt to lose sight of the great inventive genius that was required to devise and prepare apparatus suitable for their public production. Nowhere has the genious of Tesla been displayed to better advantage than in the production of suitable means to the desired ends, and the last public announcement he has made was a description of a mechanical electrical oscillator, by which his investigations of alternating currents would be facilitated." In conclusion Mr. Perry says: "My own estimate of Tesla is that his is one of the most vigorous and original minds the world has ever produced. Whether he will ever rank with Faraday, whom he resembles in many ways, I do not know, but there is no one in history whose work and character so closely resembles Faraday's, to my mind, as Tesla's. But Tesla's work is not finished. He is now engaged in something which, he tells me, he regards as the best work he has ever done. What it may be the near future will disclose. It is unfair to write one's elogium until his work is done. Tesla's work, perhaps, has only commenced."

THE PROBABLE EVOLUTION OF THE ELECTRIC RAILWAY.

The current number of the Engineering Magazine has an article under the above title by Irving Hale, that contains many interesting ideas, from which the following extracts are taken: The development of the electric street railway has been so rapid, its acceptance by the public—except in a few of the largest and least progressive cities—as the best system of rapid transit yet devised is so general, and the history of its triumph in the face of bitter prejudice and opposition is so fresh in the minds of all, that it would be a waste of time to discuss this branch of the subject.

At the outset of the discussion, the inquiry is naturally suggested as to what can be gained by substituting for the locomotive, in which steam power is produced on the spot and applied directly to its work, a costly and complicated system consisting of a stationary steam plant, costing more than the locomotive; electric generators costing about as much as the steam plant and wasting eight to ten per cent of power in the process of conversion, expensive line work or storage batteries (according to the system used) wasting another fraction of the power, electric motors on the cars exceeding the locomotives in cost and causing a loss of another ten per cent—all this for the doubtful privilege of running our trains by electricity. There must certainly be some strange compensating advantages to justify such a proposition.

In the first place, power can be produced much more cheaply in a stationary plant consisting of compound condensing engines supplied by boilers of the most efficient type, equipped with automatic stokers and grates for burning cheap slack coal, than in a locomotive where economy of fuel and labor must be sacrificed to economy of space.

From an engineering standpoint, one of the most important advantages of electricity is the facility with which the weight of the car itself and its load of passengers can be placed upon the wheels to which the power is applied, thus utilizing this weight to give the necessary traction. The problem of applying steam direct to the wheels of the passenger car is a difficult one and has never been attempted on a large scale. A separate locomotive must be used, and this locomotive must have sufficient weight upon its drivers to give the necessary adhesion to enable it to exert the required traction force upon the train which it is pulling, the safe weight upon each wheel being limited, the total maximum weight on the drivers is determined by the number of wheels to which the steam power can be applied without too much complication and regidity of truck. The power of the locomotive is also limited by the size of the boiler that can be mounted on its wheels by the amount of water and coal that can be carried and by the capacity of the fireman to feed the furnace. Boiler, tender, fuel and water, while necessary for the operation of a steam locomotive and utilized in part for giving the required adhesion of the driving wheels, are, in one sense, so much dead weight to be carried. All these difficulties and objections can be avoided if motors can be used requiring neither fuel nor water, applied direct to the axles of the car and utilized for traction, the weight of car and its paying load.

The electric motor, supplied from a wire with current generated in a distant power station, exactly meets these requirements. It is not a difficult problem to mount a 200 horse-power on each of the six axles of two six-wheel trucks, carrying a car of large dimensions accommodating a hundred passengers or more, the load being distributed equally on the twelve wheels with every pound of motors, car and passengers utilized for traction, enabling this 1,200 horse-power locomotive, which is a passenger car in itself, to haul as heavy a train of additional cars as could be pulled by a steam locomotive of the same weight and power. It has even been suggested that motors might be attached to each truck of every car in the train. While this would be possible, it would involve undesirable complications in the connections between the cars and more especially in the device for controlling the motors. The tendency in electric railroading will probably be towards more frequent and shorter trains, consisting of either a passenger-car-locomotive hauling one or two cars, or preferably of a single car of mammoth dimensions, equipped with its own motive power and avoiding all the objections of long loosely connected trains. For such service electricity is peculiarly adapted and is, in fact, the only power suitable for the purpose.

The advantages of electricity, which partly or wholly compensate for its greater cost, may be summarized as follows: Higher efficiency or economy of steam plants; saving in repairs; utilization of weight of car and passengers for adhesion; greater comfort of passengers; increased speed.

The question of relative economy of the two powers depends so much on circumstances and is so uncertain in the present lack of experience with electricity in this service, that it is scarcely possible to make a reliable comparison. The subject has been sufficiently investigated, however, to show that where the conditions are suitable, electricity will compare favorably with steam on the basis of cost of operation. Where this proves true, its probable gain in speed and indisputable advantages in comfort will certainly turn the scale in its favor.

Because electric power possesses so many attractive and advantageous features for railway work, it by no means follows that it is suitable for all roads. Like steam, it has its limitations, although in a different direction, and the conditions must be favorable to permit its satisfactory and economical use.

The natural conclusion from this comparison is that the trolley system will find its most favorable application on roads with heavy traffic where the stations can be placed at moderate intervals and given steady work, while for lines with less frequent trains, the storage battery offers the most hopeful and in fact the only economical solution.

When the storage battery can be made at half the present price, with twice its present life and capacity per pound of battery, and with a safe and fairly efficient discharge rate twice as high as the present limit, conditions by no means hopeless, it will become a very formidable rival of the trolley.

As the electric road is only six years old and scarcely anything has been done as yet towards the operation of long distance railways by electricity, it may be considered a little early to venture any well-defined predictions on the subject. The indications are, however, that within five years electricity will be the generally accepted power for elevated and underground roads as well as for surface street car service; that in ten years numerous inter-urban roads from ten to thirty miles in length will be electrically equipped; that in twenty years some of the large railway systems enjoying the heaviest traffic will consider electric passenger service essential to their welfare; that, both for the convenience of the public and economy of operation, the tendency will be towards more frequent and smaller trains; that a maximum speed of 150 miles, and a schedule rate of 75 miles per hour will not be considered remarkable; and than within the life of the present generation we will see the present long train of loosely coupled cars with their restricted space, poor ventilation and light, imperfect facilities for viewing the scenery, and annoyances from smoke and cinders, give way to a single car of liberal dimensions, shaped on scientific lines to cleave the air at high speeds with minimum resistance, equipped with noiseless electric motors, free from the disagreeable products of the steam-locomotive furnace, designed to afford the passengers an unrestricted view in all directions, perfectly ventilated, lighted by electricity, and capable of a speed that will cover the distance from New York to Chicago between sunset and business hours the next morning.

STORAGE BATTERIES IN POWER PLANTS.

It now seems very likely that before long several railway stations will put in batteries to steady the load on generating machinery and take care of extreme variations. The plant about to be installed at Merrill, Wis., will do several varieties of work, but the advantages would be just as pronounced with a railway station pure and simple. Such use of batteries in railway stations has been talked of in this country for several years, but it was left to Zurich, Switzerland, to try the first experiment along this line. The reason for the slowness of this country in adopting this method is partly in the fact that it is the smallest stations that suffer most from load variations, and such stations are not as independent in practice as the larger plants. The main reason, however, is the uncertainty as to the life of the batteries and a general indefiniteness as to the saving that will be effected. This reason is now no more, as we learn that a certain storage battery company is prepared to make an offer to any railway company that is as definite as can be desired. The proposition is about as follows: Suppose, for example, a road is going to be put in a plant with a maximum capacity of 500 horse-power. Its average load will be about 250 horse-power, and if a battery is used, only 250 horse-power of engines, dynamos and boilers will have to be installed, the rest being taken care of by the storage battery. The battery company proposes to install the 250 horse-power battery for the same money that it would cost to put in an additional first-class steam plant with triple expansion engines to take care of the load were the battery not used. This proposition includes the switchboard and all the regulating appliances for the battery. It is further proposed to maintain the battery for 10 per cent of its first cost, and if the maintenance bill runs below 10 per cent to give the railway company the benefit of it. This is certainly a definite enough offer and guarantee. Now comes the question of the operative economy of the proposed plan. As to first cost there would be no difference if the steam plant was triple expansion in both cases. The maintenance will also be about the same, although the engines in the battery plant ought not to require as many repairs as the others because they work under a steady load. However, machinery is now made so that it will stand the hard knocks of railway work, and the main advantages of the battery will have to be counted in the savings that will be brought about by giving the engines and dynamos a steady load and allowing them to be entirely shut down during hours when the load is very light. The results of various tests on different roads shows that engines on a street railway load are about 30 per cent less efficient than if on a constant load. Whatever the engines used, therefore, it is safe to count on a saving of 30 per cent in power generation. Against this there is a loss of about 20 per cent of the power that goes through the batteries. Counting roughly that one-half of the output goes through the batteries, this would mean a loss of 10 per cent or one-third of the 30 per cent saving. The storage battery plant, according to this approximate figuring, would therefore have an efficiency 20 per cent higher than the corresponding ordinary steam plant. Although the first cost is not as low as we had been formerly led to expect, this 20 per cent saving in operation is worth trying for, and it is not unlikely that some additional plants will before long install storage batteries. It is also very probable that when it comes to actual business the battery company might better its offer, so as to make a double inducement to install such a plant.—Street Railway Review.

CONDUIT ELECTRIC RAILWAYS.

Cassier's Magazine for September contains an article on this subject by Joseph Sachs. Many of the underground systems in use and proposed are described and illustrated by the author. From the article we reproduce the following: "The writer is of the firm belief that an open slot continuous wire conduit can be devised that will be commercially practical and efficient and at a cost which will certainly compare favorably with the cable. The main difficulty with conduits that have previously been experimented with, appears to have been the extremely meagre dimensions, bad location of the contact wires and lack of proper drainage facilities and of protection of the wire from moisture. With a properly designed conduit, of ample dimensions and good drainage to start with, it would certinly appear to be within the powers of electrical engineers to so locate and insulate the wires as to keep them in proper working condition. The voltage or pressure used on the wires is, however; a most important item to be considered. In the various unsuccessful trials with the conduit it has been the practice to use very nearly the same pressure as that of the overhead system. This should be very much reduced. The conduit roads in actual operation are using only 300 volts or thereabouts. With even a lower pressure success can certainly be more readily obtained. With a direct current this could not very readily be accomplished without a large outlay in copper. It would appear, however, that some alternating current method of distribution could be devised which would be particularly fitting for this purpose, if a practical motor could be produced.

"But inventors have not confined themselves to open conduits. A large variety of modifications of open conduit and other plans have been patented to meet the conditions that the various forms of open slot conduit have thus far been unable to fulfill in all but the few cases mentioned. Most of these have been on paper only, and in the form of models, while the various plans that have been actually tried have appeared even less capable of meeting the severe conditions of everyday street railway service than the open slot, bare wire conduit, and none of these plans have seen even partial commercial success. Some of these systems are highly ingenious and may be developed to commercially practical conditions; most of them, however, are of a rather dubious practicability.

PARALLELING STEAM ROADS.

Electric railways for city and suburban passenger traffic have proved such good investments that the extension of this method to lines connecting adjacent towns was but a natural step. The additional revenue to be derived from these lines in the transportation of freight as well as passengers is also an important factor in estimating upon the income of such roads and hence it is not surprising to note the steps which have been taken in many directions towards the building of electric railroads into districts not heretofore reached by the steam road. Up to within a comparatively short time these country roads were looked upon with favor by the steam railway companies, who welcomed them as valuable feeders to their own systems, and they encouraged the idea to the fullest extent. What makes such roads all the more popular is the generally bad condition of public highways, and it is probable that in this direction will be found the relief so long sought for. But it would seem that, not content with the mere office of acting as feeders for the steam roads, a number of electric railways, such as that now in course of construction between Philadelphia and New York, are actually paralleling steam roads; and other similar roads contemplated, especially in New England, would make it appear that the steam roads will soon have to face a problem the solution of which may bring about a most radical modification in their method of operation.

It must be apparent that an electric railway, taking up and letting off passengers at any point on the line, possesses advantages which go far towards outweighing lower speed as compared with the steam roads; and even this comparison may be only fairly made with respect to express trains on steam roads, for it is safe to say that the speed of electric intra-urban roads would compare favorably with that of most of the way trains on this continent at the present time.

But while steam railway managers have looked with complacency upon the electric roads as feeders to their own systems they have in more than one instance of late had to face the electric road as a competitor; and we believe the time is not far distant when a serious struggle for supremacy between the two, at least for short haul traffic, will be in full progress.

We can find no better illustration of the gradual reaching out of the electric railway than is presented by the conditions existing in the State of Connecticut where electric roads are gradually but surely paralleling the main steam lines, such as the New York, New Haven & Hartford, and the New York & New England Railroads, and must eventually drain them of much of their local traffic. That the officials of these steam roads foresee the impending struggle crops out in some very significant remarks recently made by one of them. In the opinion of that official, if such competition should ever become serious he could see no reason to prevent the steam roads from electrically equipping the two outer tracks of their four track systems, and thus meeting the electric roads on their own ground. It must be admitted that this argument is unanswerable, but the wonder is that with the full knowledge of the coming course of events steam railroad managers should want to delay longer a step which they confess they may soon have to take. The remedy here proposed is of course only applicable to four track roads, whose number can be counted on the fingers of one hand, so that there is little to interfere with the prospects for remunerative business for the cross-country electric railway. On the other hand there is no good reason why single or double track steam roads should not avail themselves of the opportunity, and by constructing auxiliary parallel lines to their own roads reap the profit which will inevitably go elsewhere unless they act promptly and with decision.—Electrical Engineer.

The national rules for electric wiring have been adopted by the Board of Public Works, of Cedar Rapids, Iowa. Other improvements have been made in the same line, water works and fire department improved.

THE CHAS. E. GREGORY COMPANY, Chicago, report the following sales for September: Home Electric Light & Power Company, Etkhart, Ind., one 50 light American, and one 50 light Stardard arc dynamo, 100 lamps, 100 hoods and 100 globes; Mrs. S. Livingstone, Chicago, one 1 horse-power Eddy motor; Eugene Vallens & Co., Chicago, one 1 horse-power Belding motor; Barrett & Barrett, Chicago, one 2 horse-power Excelsior motor; Henry Electric Company, Henry, Ill., one 30 light Sperry arc dynamo; O. H. Parker, Anniston, Ala., one 25 horse power C. & C. motor; Ford & McGregor, 21 Edison arc lamps; T. Braasted, Ishpeming, Mich., one 5 horse-power T.-H. motor; D. A. & C. A. Goodyear, Tomah, Wis., one 3 horse-power Jenney motor; Hatch Cutlery Company, Buchanan, Mich., one 25 horse-power Edison motor; Taylor, Dee & Mack, Chicago, one 2 horse-power Sprague and 110 horse-power U. S. motor; W. Kreilow, Willow Springs, Mo., four "D" T.-H. lamps; Lederer & Oppenheimer, Chicago, 14 Edison arc lamps; R. Roach, Chicago, one 3 horse-power Eddy motor; Four Lakes Light & Power Company, Madison, Wis., one 3 horse-power Jenney and one 3 horse-power Eddy motor: Crane Elevator Company, Chicago, one 1 horse-power Crocker Wheeler motor: Goltz & Sinclair, Milwaukee, one 1 horse-power Eddy motor; Racine Dredging Company, Gladstone, Mich., one 3 light Excelsior arc dynamo; Field Columbian Museum, Chicago, one 45 light Brush arc dynamo and 45 lamps; D. S. Huff, Morris, Ill., one 1½ kilowatt Edison motor; Chicago Turn Gemeinde, Chicago, one 5 horse-power Excelsior motor; Dundee Rapid Transit Company, Elgin, Ill., one 20 horse-power Sprague motor; Quincy Floor Plate Manufacturing Company, Quincy, Ill., one 50 light U. S. dynamo; Metropolitan Electric Company, Chicago, one 7 light Bain dynamo.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Granville, O.—Mr. W. G. Kendall desires to correspond with a good party, in regard to a commercial plant.

Painesville, O.—The Commercial Electric Company will put in 8 or 10 arc lamps, to be connected with incandescent circuit. W. N. Collister is purchasing agent.

Fort Wayne, Ind.—R. T. McDonald contemplates replacing the present incandescent street lamps with arcs.

San Jose, Cal.—The Electric Improvement Company, of San Jose, contemplates the addition of a 600 horse-power engine and an incandescent light machine. H. J. Edwards is purchasing agent.

Newport News, Va.—The Peninsula Electric Light & Power Company proposes to add 50 arc lights. T. H. Sharp is purchasing agent.

Shickshinny, Pa.—The Borough Municipal Lighting Plant will soon be completed and ready for business. W. O. DeWitt will be general manager.

Eau Claire, Wis.—The Eau Claire Telephone & Lighting Company is the successor of the Street Railway, Light & Power Company, and the Electric Light and Power Company.

Washington, Mo.—The Washington Electric Light Plant has extended its lines to Union, Mo., 10 miles distant, and furnishes lights for street and commercial purposes. A 50 horse-power engine will be added. Address A. A. Tibbe, owner.

Belleville, Ill.—The Belleville Gas Light & Coke Company will add an 80 light arc dynamo. Edward Abend, jr., is purchasing agent.

St. Johns, Quebec.—The St. Johns Electric Light Company wishes to purchase a good second-hand 1,000 light alternating dynamo.

Selby, Contra Costa Co., Cal.—W. G. Phipps is arranging for the construction of a copper refinery, and later on a gold and silver refinery. In the construction of this plant he will require at least two high speed engines 50 and 100 horse-power and two or more low voltage generators 20 to 55 volt. Direct connected preferred. Address W. G. Phipps, or Alfred Rapp, superintendent of the Selby S. & L. Co.

Durango, Colo.—The Durango Railway & Realty Company will extend its tracks two miles and add one car to its equipment.

Reading, Pa.—The Neversink Mountain Railroad Company contemplates the addition of a 600 horse-power engine. Paul D. Millholland is purchasing agent.

Frankfort, Ky.—The Capital Railway Company will construct one-half mile of additional track.

NEW INCORPORATIONS.

Chicago, Ill.—United Telegraph, Telephone & Electric Company, to operate telephone and telegraph lines. Authorized capital stock, $1000,000.

Jacksonville, Ill.—Jacksonville Electric & Power Co., to furnish electric light and power and deal in electric machines. Authorized capital, $100,000.

Lenox, Mass.—The Lenox Electric Company, to furnish electric light, power and heat, with capital stock, $20,000.

Detroit, Mich.—Recently incorporated at Detroit, the Detroit Light and Land Company; $100,000.

Caldwell, Ohio.—The Caldwell Electric Light & Water Company, to furnish light and water; $10,000.

Middletown, Ohio.—The Citizen's Electric Co., to furnish light, heat and power. Capital stock, $20,000.

Wyshington, D. C.—The Electro-Magnetic Traction Co.; $5,000,000.

New York, N. Y.—The Morse Electric Economy Company, to manufacture storage or secondary batteries; $5,000,000.

Albany, N. Y.—Standard Telegraph and Telephone Company to construct and operate telephone and telegraph systems; capital $5,000.

Great Falls, Mont.—It is reported that another copper refining plant is to be erected at Great Falls. The electrolytic process, it is said, will be used. Mr. Marcus Daly is connected with the company.

Rochester, N. Y.—Rochester Railway Company has leased the lines and equipment of the Rochester Electric Railway Company, running from Rochester to Ontario Beech, for a term of 50 years; papers filed.

Hartford City, Ind.—The Hartford Electric Street Railway Company; $100,000.

Columbus, Ohio.—Central Electric Railway Company recently incorporated to build and operate electric railways and to furnish current for heat, light and power. The company, it is said, contemplate a network of interurban lines in Ohio.

NEW BOOKS.

The Telephone Hand-Book. By Herbert Laws Webb, author of a "Practical Guide to the Testing of Insulated Wires and Cables." First Edition, 1894. Chicago. Electrician Publishing Company. Cloth. Price $1.00.

As its title indicates, this book is intended as a hand-book and not a complete treatise on the telephone. The ground has, however, been sufficiently covered to meet the wants of nearly all. The fundamental principles upon which the operation of the telephone are based are touched upon in the first few chapters. The telephone instruments and the inventions in connection therewith are treated in historical order. The batteries used with the telephones are described and also their care and practical management. The different parts of the telephone system are described in order—line construction, installation, inspection, maintenance, etc. Exchanges, private lines, long distance, lines, duplex telephony and simultaneous telegraphy and telephony, the author carefully describes, with the use of numerous cuts, in the last chapters of the book. The book is closely printed and condensed as much as possible, giving it a convenient hand-book size.

Electric Lighting Plants: Their Cost and Operation. Data compiled from station reports of electric lighting plants employing overhead circuits, with suggestions pertaining to the information usually desired by the non-technical purchaser. By W. J. Buckley. Chicago, 1894: Wm. Johnston Printing Co. Price $2.

This modest volume of nearly 300 pages with numerous inserts, drawings and tables, has been prepared especially for the purchasers of apparatus and those contemplating the construction and operation of central stations. The information concerning the cost of the station equipment is but a small part of that which the volume contains. The author has gathered the facts from the central stations which, in the number of years they have been in operation, have shown where improvements could be made, the best building to be erected and equipment installed for a given output and also the best method of operating. The author, for nearly ten years, has been identified as a salesman with one of the older manufacturing companies, and therefore knows the information most desired. His opportunities for gathering the data he has here compiled, have been excellent, and advantage has been taken of them.

Eletricity at the Columbian Exposition, including an Account of the Exhibits in the Electrical Building, the Power Plant in Machinery Hall, the Arc and Incandescent Lighting of the Grounds and Buildings, the Transmission of Power for the Operation of Machinery, the Subway and Conduits, Electric Fountains, Searchlights, Intramural Road, Electric Launches, Electric Elevators, Lighting of the Ferris Wheel, etc. By J. P. Barrett, Chief of the Department. Chicago, 1894: R. R. Donnelly & Sons Company; 500 pages; cloth, $2 50.

While the subject might have been treated in many different ways, the author has undoubtedly adopted what will prove the most satisfactory method. The facts are presented and the reader is allowed to enlarge upon the subject as he chooses. The electrical features of the exposition, the exhibits, etc., are described, the more important at some length. The ground has, in this respect, been fully covered. Little attention has been given to the historical part of this department, and more attention to what the visitor saw. The power stations are described at some length, but with the exception of the intramural road no figures are given regarding operating expenses and maintenance. The illustrations, which are generously distributed through the contents, are of a high order, both as regards the original photographs and the engravers' reproductions. Being the only volume published exclusively on this subject, it will be preserved by all interested in the industry, as it presents the applications of electricity at the present time with the most improved appliances. The author, having been chief of this department at the Exposition, the work may be considered official.

FINANCIAL.

A fair business is reported for the past month, but no very large contracts. The manufacturers report sufficient orders ahead to keep in operation some months, with good prospects for a continuance of the improved business of the past few months. The stock market has shown little activity in electrical securities. The prices are about as last month.

The West End Street Railway of Boston closes its fiscal year with earnings for the 12 months in excess of six millions, and net earnings $2,100,000. It is expected that this will leave a surplus after paying the dividends.

Among the recent failures of electrical houses are H. Ward Leonard & Co., of 136 Liberty street, New York, and Taylor, Dee & Mack, of Chicago. Mr. H. Ward Leonard was appointed receiver of the former. A statement issued shows nominal assets $177,641.10, and liabilities $64,000. The assignment was made necessary on account of a portion of the assets being tied up in the Cayadutta Electric Railway Company and the remainder being insufficient to meet the liabilities which were maturing. A statement has not yet been filed by the receiver of Taylor, Dee & Mack.

Construction work on a number of the large electric street railway systems is being pushed rapidly forward. The Chicago City Railway recently opened up a new electric line about five miles long, and is pushing work on extensions. On the West Chicago Street Railway the work of reconstruction preparatory to the operation of the cars, now drawn by horses, by electricity is going forward. Work has also been commenced on the proposed line from Pittsburg to McKeesport. This road is to be double-tracked and well constructed. In the operation of this road it is intended to run both express and accommodation trains, the express trains making but one or two stops. There are a number of these large roads which are taking advantage of low prices and the abundance of cheap labor to make improvements and to build extensions.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING Sept. 25.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	195
" " "	Bds. 1893.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co... ...	Com.	14,000,000	100	....	....	89
Commercial Cable Co	Com.	7,716,000	100	....	....	125
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	F. Q.	115
" " " ...	C.Bds. 1898.	71,000	100	6	M. & S.	.....
" " "	C.Bds. 1901.	586,500	100	6	M. & N.	......
" " Brooklyn..	Com.	2,500,000	100	....	Q. F.	85
" " " ..	1st. 1940.	500,000	100	5	A. & O.	100
" " " ..	Regis.	....	100	5	A. & O.	.....
" " Chicago...	Com.	3,000,000	....	8	Q. F.	135
" " "		2,500,000	....	....	....	......
" " New York.	Com.	7,998,000	100	....	Q. F.	100
" " "	1st 1910.	2,562,000	100	5	M. & S.	107
" " Phila......	Com.	1,473,000	100	....	....	128½
" " "		....	....	5	....	......
Fort Wayne Elec. Co...... ...	Com.	4,000,000	25	....		3
General Electric Company.	Com.	30,457,000	100	....	....	40½
" "	Prf'd.	4,251,900	100	....	....	70
" "	Deb. 1922.	10,000,000	100	5	J.-D.	86
Gold & Stock Tel. Co............	Com.	5,000,000	100	....	Q. J.	....
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	90
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	....	......
Thomson European Welding Co.	Com.	1,500,000	100	....	....	......
Thomson-Houston Elec. Co . .	Series D.	120,000	10	....	....	5⅜
Thom'n-Houst'n Intern. Elec. Co.	Com.	600,000	100	...	....	.....
" " " "	Prf'd.	400,000	100	....	....	......
United Electric Securities Co....	Com.	1,000,000	100	....	....	......
" " "	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	91,820,000	100	....	Q. J.	83
" "	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass' ing.	5,333,940	50	....	....	36½
" " "	1st Pf. Cum.	3,755,700	50	7	....	51
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R..............	Com.	6,000,000	10	....	Q.-J.	170
" "	1st Bds. 1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	....	Oct. 1.	......
" " " ..	1st Bds. 1909	500,000	100	5	J. & J.	.....
" " " ..	Certf. 1894.	300,000	100	6	J. & J.	.....
BUFFALO—						
Buffalo St. Railway..............	Com.	5,370,500	100	5	....	......
" "	Bds. 1931.	5,000,000	100	....	F. & A.	......
BOSTON—						
West End St. Railway...........	Com.	9,085,000	50	..	J. & J.	47
" "	Pfd.	6,440,000	50	5	J. & J.	77
" "	Bds. 1902.	3,000,000	100	....	M. & N.	100½
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	......
" "	Prf'd.	1,000,000	100	5	A. & O.	.....
" "	1st Bds. 1930	6,000,000	100	....	J. & J.	......
NEWARK. N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	....	....	27⅜
" "	Bds. 1930.	6,000,000	100	5	J. & J.	81½
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	155
" "	Bds.	2,000,000	100	...	....	......
PITTSBURGH—						
Duquesne Traction Co........ ...	Com.	3,000,000	50	...	....	26½
" "	Bds. 1930.	1,500,000	100	5	J. & J.	103
Fed. St. & Pleas. Val. R. R.......	Com.	1,000,000	50	....	J. & J.	20
" " " " "	Bds. 1919.	1,250,000	100	5	J. & J.	102
Pittsb'gh, Aleg. & Man. R. R....	Com.	3,000,000	50	....		37
" " "	Bds. 1931.	1,500,000	100	5	J. & J.	103¾
Pittsburgh & Birming. R. R.....	Com.	3,000,000	25	....	....	12½
" " "	Bds. 1929.	1,500,000	100	5	M. & N.	95
ROCHESTER—						
Rochester Railway Company.. .	Com.	5,000,000	100	...	....	67
" " "	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway..............	Com.	2,500,000	100	....	Q.-J.	99
" "	Bds. 1910.	1,500,000	100	5	J. & J.	102
St. Louis & Suburban............	Com.	2,500,000	400	....	....	17
" "	Bds. 1921.	1,400,000	100	6	F. & A.	105
Union Depot Railway...........	Com.	1,200,000	100	....	....	100
"	Bds. 1910.	1,000,000	100	6	A. & O.	105

TRADE PUBLICATIONS.

The Iona Manufacturing Company, 336 Congress street Boston, has sent out price list No. 3, for September, of its electrical specialties manufactured. It supersedes all previous lists. The extensive line of switches, sockets, fuse blocks and cut-outs, together with watchmen's registers, etc., are illustrated as well as listed in this pamphlet. A number of new specialties are noticeable. The company calls attention to its facilities for the construction of models for inventors or special work of any kind.

A pamphlet entitled "Advertising for Profit" has been received from the Manufacturers' Advertising Bureau & Press Agency, of New York. It contains considerable imformation regarding advertising and the facilities and experience of the company. Mr. Benjamin R. Western, who is at the head of this agency, served many years as a practical journalist and was prominently connected with several of the most successful trade journals. A list of clients and many letters from clients expressing the pleasant and profitable relations with this bureau, completes the contents of the pamphlet.

The catalogues issued by the Siemens & Halske Electric Company of America for September treat of the bipolor generators and motors, type L H, and generators and motors, type I. Illustrations of plants where these machines are in use are shown and detail cuts of the machines accompany the descriptions, of same. In the preface is given a short history of the firm of Siemens & Halske. Each number contains a list for reference of prominent plants using this particular type of Siemens & Halske apparatus. The addresses of the district offices are given, making the catalogues books of reference. They are bound in neat, colored covers.

Cataloge No. 67 recently issued by the Westinghouse Electric & Manufacturing Company, is devoted to the multipolar generators and motors. The catalogue is in every particular up to the standard of excellence which the company has maintained. The design of every part has received attention. The paper, the engravings and press work are of a high order. The diagrams and tables giving sizes of different parts are compactly arranged and the descriptions are clearly written. There is also appended wiring tables for 100 and 500-volt circuits with varying losses. The method of using the tables is described and several examples are given illustrating their use.

The variety of styles and sizes of electric cables is constantly increasing. Each catalogue issued by the manufacturers shows a number of new cables. The catalogue just issued by the Norwich Insulated Wire Co., of 44 Broad street, New York, is full of the latest designed insulated conductors. The illustrations show an extensive line of lead covered cables for high and low tension circuits, multiple conductor and multiple circuit telephone and telegraph cables, for interior wiring, for underground submarine or aerial work and for any place that electrical conductors are used. Telegraph cables are made in accordance with specifications desired or for any purpose. The pamphlet is well gotten up and presents by means of the numerous colored cuts the insulated conductors manufactured by this company in an excellent manner.

Electric and combination fixtures together with electrical supplies and material for interior wiring, are presented to the trade in a recent catalogue issued by the Dale Manufacturing Company, of 22 Cortlandt street, New York. The line of fixtures shows an extensive variety of designs. A large number of styles of portable desk standards, brackets, plain, extension and highly ornamental, electroliers, car lights and ceiling lights are illustrated. In connection with this line of fixtures, fixture glassware and numerous specialties that are used in connection with same are shown by numerous cuts. The supplies and specialties embrace the usual lines of such goods as have by their good qualities become standard articles. The catalogue is greatly condensed so as to make it as handy as possible. It is indexed and gotten up in a convenient form.

Asbestos goods of various kinds are well presented in a catalogue recently issued by Ed. Wertheim of 207 Lake street Chicago. The applications of this material have greatly multiplied during the last decade as shown by the extensive line of articles described in this book. For engineers it has become almost a necessity and for packing, gaskets, etc., it is manufactured in a number of styles. For pipe and boiler coverings it is extensively used. It is also used for belting, for building paper and for the protection of electrical conductors. This catalogue, which is well gotten up and bound in board covers, illustrates and describes the asbestos as manufactured for the different uses. These products come from the works of Louis Wertheim, Frankfort-on-Main. An elaborate display of the products were made at the World's Columbian Exposition in the German section, for which a large number of awards were received.

The Johnson system of temperature regulation is described and illustrated in a pamphlet recently issued by the Johnson Electric Service Company. The introduction deals with the methods of heating large buildings from a single source and the difficulties encountered in giving each part of the building its exact amount of heat without a system of temperature regulation. The Johnson system, as explained, automatically regulates the temperature of each office or appartment by closing the source of supply as sood as the temperature has reached the desired degree and opening it as soon as the temperature is lowered even a trifling amount. The system, which is complete in every respect, is used in a large number of the public and private buildings of the country. The apparatus employed is described and illustrated in detail and the application to various kinds of heating systems. Sectional views are shown of buildings illustrating the application of the system. A long list of public buildings and institutions, private residences, etc., is given.

A number of new catalogues have been issued by the Mather Electric Company, of Manchester, Conn., describing the various electrical apparatus manufactured. The different numbers form a series which comprise the entire products of the factories. They are uniform in design and general make-up. The cuts are well executed and the descriptive matter is concisely written. The new types of electrical generators and motors are presented. The illustrations are very clear and show both the general appearance and details of the machines. The catalogues are of a convenient size and to anyone desiring to investigate one line of apparatus is not burdened with a lot of unnecessary information. The compiler has not neglected to add to each part such information as will be found valuable in the use of that class of machinery. Wiring tables are given and also many pointers for the care and operation of this particular apparatus. These catalogues are being distributed in the west by J. Holt Gates, the general western agent, with offices in the Monadnock block, Chicago.

PERSONAL.

Mr. A. L. Daniels, manager of the Akron Insulator and Marble Co., Akron, O., was in Chicago last month.

Mr. L. J. O'Reilly, formerly with the A. B. C. Company, is now connected with the Dale Mfg. Co., of New York.

Mr. R. V. Scudder, of the Western Electrical Supply Company, St. Louis, was in Chicago for a few days recently in the interests of his company.

Mr. W. H. McKinlock, president of the Metropolitan Electric Company, spent several days outside of Chicago last month among his various customers.

Mr. Samuel L. Phillips has been elected president of the Metropolitan Railroad Company, Washington, D. C., to succeed the late William J. Stephenson.

Mr. H. G. Field, of Field & Hinchman, Electrical and Mechanical engineers and contractors, of Detroit, Mich., was in Chicago last week on business of the firm.

Mr. B. J. Arnold, the well-known electrical engineer, has been appointed Chicago local honorary secretary of the American Institute of Electrical Engineers.

Mr. William B. Roberts, formerly general manager of the Rockford Electric Mfg. Co., is now the manager of the Detroit office of the Johnson Electric Service Co.

Prof. William A. Anthony is now associated with Mr. Edward P. Thompson, M. E., of New York, and will have charge of the engineering and expert work of the office.

Mr. J. B. Wallace, of the Wallace Electric Co., Chicago, made a short fishing trip in the northwest last month. On his return to Chicago Mr. Wallace started out on a business trip, from which he has recently returned.

Mr. W. S. Hine, of the Wallace Electric Co., Chicago, returned a few days ago from a business trip in the East. Mr Hine visited New York and Boston on his trip, spending several days at the factory of the Stanley Electric Co., at Pittsfield, Mass.

Mr. Edward P. Sharp, of Webster & Beach, Boston, was in Chicago for a few days last month. The firm represented by Mr. Sharp is a comparatively new one, having been organized recently for the purpose of dealing in electrical appliances for electric light and railway service.

Mr. M. Hebgen, superintendent of the Butte General Electric Co., Butte, Mont., was in Chicago for a few days last month. Electrical matters Mr. Hebgen reports as being in a very flourishing condition in his city. The hard time are not appreciable, and business is increasing so far as his company is concerned.

Mr. F. E. Degenhardt, the well-known Chicago representative of the Standard Underground Cable Company, left last month for Denver, here he will join Mr. A. Chanute, of the Globe Smelter Company, for a few days' hunt after large game. This is the first vacation Mr. Degenhardt has had for ten years and he proposes to enjoy it in the best manner possible.

BUSINESS NOTES.

The Bryant Electric Company, Grier Bros., managers of the western office at Chicago, has sent out recently to the trade. a neat folder, in which are illustrated the specialties most recently placed upon the market.

White-Crosby Company, Philadelphis, has been awarded a contract amounting to $63,487.04, by the Electrical Subway Commission, of Baltimore, for the construction of subways. The Camp class of terra-cotta conduits laid in brick will be used.

The Electrical Engineering Co., Minneapolis, Minn., is at present busy in filling numerous orders for supplies and specialties which it handles The company reports a considerable increase in the volume of its business over that of last year, and is looking for a much larger increase during the coming year.

W. T. Van Dorn, manufacturer of the Van Dorn draw bar for electric street railway cars, is equipping 100 cars with this device for the new Metropolitan elevated road in Chicago. The cars are manufactured by the Pullman company. This device, although recently put on the market, is in use on some 1,000 cars.

The Phoenix Carbon Mfg. Company, DeKalb street, St. St. Louis, Mo., has commenced the manufacture of electric light carbons and carbon specialties. This company has recently been organized by Mr. S. G. Booker, who is well known to the electrical trade through his prominent connection with the manufacture of electrical goods. He was formerly manager of the Fidelity Carbon Company previous to its absorption by the National Carbon Co.

Ball & Allen, Messrs. W. B Ball and J. R. Allen, will hereafter conduct the business of consulting mechanical and electrical engineers, at 1627 Monadnock Blk., Chicago, previously conducted by Mr. Ball. The business has grown rapidly since it was started by Mr. Ball a few years ago and the work which is now in the hands of the firm indicates that their services will be in still greater demand. Mr. Allen is not a stranger to the industry, having been for some time connected with the Louis K. Comstock Company, consulting and contracting electrical engineers.

Edward P. Thompson and Prof. William A. Anthony, 5 Beckman St., New York, are now associated together and will make a specialty of electrical patent and engineering cases. To architects and engineers as well as to cities, corporations and individuals, they offer their services in the planning and supervision of electrical plants. To inventors their services are offered in writing specifications for patents upon inventions of all kinds. Each is well known, having long been actively interested in the industry.

Western Electrical Supply Company, St. Louis, Mo., is now located at 10 and 12 Ninth St., having removed to the new quarters on September 1st. The company will carry a larger stock of electrical supplies than ever before. The conveniences for the transaction of business have been improved and the customer will be benefited by the change. Gas, electric and combination fixtures will form one of the important departments of the sales rooms. Prompt delivery is assured on all goods—an item that is always of value to the trade.

The Joseph Dixon Crucible Co., Jersey City, N. J., manufacturers of lead pencils, crucibles, stove polish, and other graphite products, have felt the necessity of stiffening the backbones of their salesmen who have complained of competitors' cut prices, and do it after the following fashion: In times like these, when work is none too plenty, and the manufacturer is anxious for orders and the salesman likewise, there is great temptation to cut prices for the sake of getting a quantity of business and thereby deluding ourselves into the idea that we are prosperous because we are busy, forgetful of the fact that the more business one does at a loss the slimmer will be the bank account at the end of the year. Prices once broken down are hard to re-establish, and it is even doubtful if they can be re-established. Furthermore, a manufacturer who once gets the reputation of making cheap goods will find it difficult to obtain good prices even for his best goods, and fine products at good prices are always in fair demand at all times.

THE KNAPP ELECTRICAL WORKS, Chicago, which went into the hands of a receiver lately, is making up all the material on hand, as well as selling out all of the manufactured articles in stock. Mr. Lucas, the receiver, is pushing things as fast as he can and hopes to close out the entire business within 60 days if possible. Goods are selling at very low prices and buyers throughout the country are taking advantage of the opportunity. The sales are being looked after carefully by Mr. M. A. Knapp and Mr. M. B. Austin, whose long connection with the company give them every advantage in disposing of the stock.

THE CONSOLIDATED CAR HEATING COMPANY, Albany, N. Y., has recently received an order for what is considered the largest order for electric heaters ever awarded. The order is from the Union Railroad of Providence which is a syndicate of electric roads covering the cities of Providence and Pawtucket and the neighboring towns of Coventry, Cranston, Cumberland, East Providence, Johnston, Lincoln, North Providence and Warwick, and operating some one hundred and twenty miles of road. The order is for heaters for two hundred cars. The Consolidated company is also equipping at the present time six other roads.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, has arranged to represent the Heisler series lamp exclusively in the west and carry a large and complete stock in Chicago. The advantage of this arrangement will undoubtedly be appreciated by users of series incandescent lamps, who have hitherto been compelled to send their orders to eastern houses for shipment direct from eastern points. The Heisler series incandescent lamp is too old and well-known an article to require any comments at our hands and the Electric Appliance Company have undoubtedly added another good specialty to its celebrated line.

THE GILLILAND TELEPHONE COMPANY, of Chicago, are meeting with good success in the introduction of their telephone. The instrument is made in a substantial manner and is artistic in form, consisting of magneto mounted on back-board with desk, bi-polar magneto transmitter, and telephone receiver with cord, and is sold outright at a fair price. Their central office and exchange system for towns and small cities is complete and comprehensive. The president, Mr. W. H. McKinlock, and the general manager, Mr. J. J. Nate, have spent the greater portion of their lives in telephone and kindred electrical interests, securing therefrom a broad and valuable experience, which are necessary factors to the advancement of telephone work.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has just added to his already important list of specialties the agency for the Sweet automatic limit switch manufactured by the Sweet Electric Manufacturing Company of Grand Rapids, Mich.; also the agency for the Royal transformer, manufactured by the Royal Electric Company of Peoria, Ill., also the agency for the dynamos and motors manufactured by the Commercial Electric Company of Indianapolis, Ind. In addition to these specialties the company has also just taken the entire out-put of a glass factory for insulators of all kinds. Business with the Metropolitan company continues very brisk in all lines. The telephone business of the Gilliland Telephone Company, whose out-put is controlled by the Metropolitan company, is also very good.

THE CENTRAL ELECTRIC COMPANY, 173 and 175 Adams St., Chicago, is receiving orders constantly for the iron armoured conduit recently placed on the market. The residence of P. H. Armour, Jr., on Michigan Ave., is to be wired in this conduit. One of the advantages of this conduit is that two wires can be run in the same tube, the Standard Underwriters' rules having been so modified as to permit this to be done. Fire proof buildings are incomplete without the interior conduit system of wiring. The trade in general supplies is reported to be good. The Central company is ready to supply any demands from its large stock. Telephone supplies are always carried in large quantities to meet any sudden demand. The railway department has a well arranged stock of electric railway supplies and prompt shipments can be guaranteed.

THE MIAMISBURG ELECTRIC COMPANY, Miamisburg, Ohio, has been very successful in the sale of the now well-known Imperial dry battery. The first battery of Mr. Burnley's has had many imitations which is certainly flattering to the excellence of that battery, but the Imperial is an improved battery, in the construction of which the wider experience of the past few years has helped to perfect. They have been tested by makers, users, dealers and experts, with the result that their use has been extended. Telephone companies have found them especially suitable for that class of service. The Burnley Cartridge battery is also meeting with much favor among the trade, and is a new departure in open circuit batteries, using sal-ammoniac as the exciting agent. The porous cup is made of a specially prepared paper, which renders it light and not easily injured or broken. The tempered copper department is reported very busy, being engaged on some large contracts. The company expects soon to place on the market a new plan of building small commutators. This will be of interest to makers of small dynamos and motors.

THE BALL ENGINE COMPANY, ERIE, PA., reports another long list of recent orders for their well known Ball engine in various sizes and for various classes of work. The number of sales of these engines is a sufficient evidence of the excellence of these engines. Recent shipments are as follows: Peninsula Electric Light & Power Co., Houghton, Mich., one 350 horse-power tandem compound; Union Colliery Co., Victoria, B. C., one 160 horse-power engine; Edson, Moore & Co., Detroit, Mich., one 80 horse-power engine: Noyes, Norman & Co., St. Joseph, Mo., one 50 horse-power engine; J. W. Parker & Co., New York City, one 50 horse-power; City of Adrian, Adrian, Minn., one 70 horse-power engine direct connected to Siemans-Halske dynamo; Celadon Terra Cotta Co., Alfred Centre, N. Y., one 100 horse-power engine; Norton Bros., Chicago, Ill., one 150 horse-power Cross compound; Morton Bros., Chicago, Ill., one 150 horse-power Cross compound; Berwick Electric Light Co., Berwick, Pa., one 160 horse power engine; Sol Heyman & Co., New York City, one 60 horse-power engine; North Sub-District School, 4th Ward, Pittsburg, Pa., one 35 horse-power engine; George W. Childs Public School Building, Philadelphia, one 60 horse-power engine; E. P. Dodge Mfg. Co., Newburyport, Mass., 1 50 horse-power engine and J. W. Parker & Co., New York City, for export, one 30 horse-power engine.

J. HOLT GATES, general agent western states of the Mather Electrical Co., reports following recent sales of Mather apparatus: New Davidson Theater, Milwaukee, two 1,000 light; A. W. Perry, Boston, Mass. (fifth order), one 350 light; Hotel Minot, New York City, one 560 light; Hoboken Quartet Club, Hoboken, N. J., one 150 light; Henry Reinhardt, New York City, one 100, one 150 light; E. P. Gleason Mfg. Co., New York City, one 250 light; Piscataquis Woolen Co., Guilford, Me., one 600 light; Danvers Insane Asylum, Danvers, Mass., one 250 light; Newport Gas Light Co., Newport, R. I., one 250 light; State Almshouse, Tewksbury, Mass., one 600 light; Whittenton Mfg. Co., Tauton, one 100, one 50 light; Weise Bros., Moline, Ill., one 250 light; Chambers Electric Light & Power Co., Truro, N. S., one 500 light; Union Central Life Insurance Building, Buffalo, one 250 light: Beck Brewing Co., Buffalo, one 600 light; Comstock Construction Co., Chicago, one 250 light, Gallagher Bros., Meridian, Miss. (third order), one 100 light; New Ford's Opera House, Washington, one 450 light; Jones Bros. Electric Co., Cincinnati (seventh order), one 50 horse-power 220 volt generator; New Pittsburg Coal Co., New Pittsburg, O., one 60 K. W. 220 voltge nerator; Morris Coal Co., Sand Run, O., one 60 K. W. 220 volt generator; Harry S. Smith & Co., Philadelphia, Pa., two 45 K. W. direct connected generators; Hartford & West Hartford Railroad Company, one 180 K. W. railway generator; Danbury & Bethel Railroad, Danbury, Conn, two 100 K. W. generators: Bloomington, Ill., Railway, one K. W. generator; Pocahontas Coal Co., one 60 K. W. power generator; Grenada Hotel, Chicago, one 500 light machine; City Water Works, Chicago, one 300 light machine; Council Bluffs Deaf and Dumb Asylum, one 600 lighter; Jas. I. Ayer & Co., St. Louis, one 30 K.W.multipolar; Odd Fellows Hall, Philadelphia, one 75, one 50 and one 30 K.W.direct connected; Henry R.Worthington, Brooklyn, one 600 light dynamo and one 50 horse generator and motors; Geo. W. Furbeck, Chicago, one 15 K. W. The factory is now being worked late at night, and orders are coming in by telephone for immediate shipment. The new Mather Multipolar Generator has met with marked favor. The Mather Electric Company also report a very large sale of their new Manchester type slow-speed stationary motors, in sizes from 3 to 50 horse-power. They have had, they assert, so much success in the introduction of these motors that they have so far been unable to keep up their orders for this class of apparatus.

HOADLEY BROS., engineers, Monon Building, Chicago, have received letters patent for their improved system of rope transmission. This system is in use in the power houses of a number of the largest cable and electric roads in the United States. Patents have also been granted in a number of foreign countries. Messrs. Hoadley Bros. have received a number of very complimentary letters from the companies using the system, from which we take the following from the Chicago City Railway, for which they they are now constructing three more 1,500 horse-power units:

CHICAGO CITY RAILWAY COMPANY.
G. H. WHEELER,
President.

CHICAGO, Sept. 9, 1894.

Messrs. Hoadley Bros., Engineers, 1030 Monon Block, Chicago.

GENTLEMEN: The engine plant furnished by your company, to operate our electric street railway lines, is very satisfactory. The Improved Wheelock engines, equipped with Hill Valve Gear, are models of simplicity and fine workmanship.

Your Messrs. Hoadley Bros.' system of rope transmission cannot be too highly commended, effectually transmitting fifty per cent more power than guaranteed, besides being absolutely noiseless.

Our operating conditions are larger than anticipated when making our contracts, but, nevertheless, we have experienced no difficulty in developing more power than guaranteed maximum, and up to date have not had one hour's delay since the plant was put into operation. We are fully satisfied in each and every particular. Yours very truly,

G. H. WHEELER.

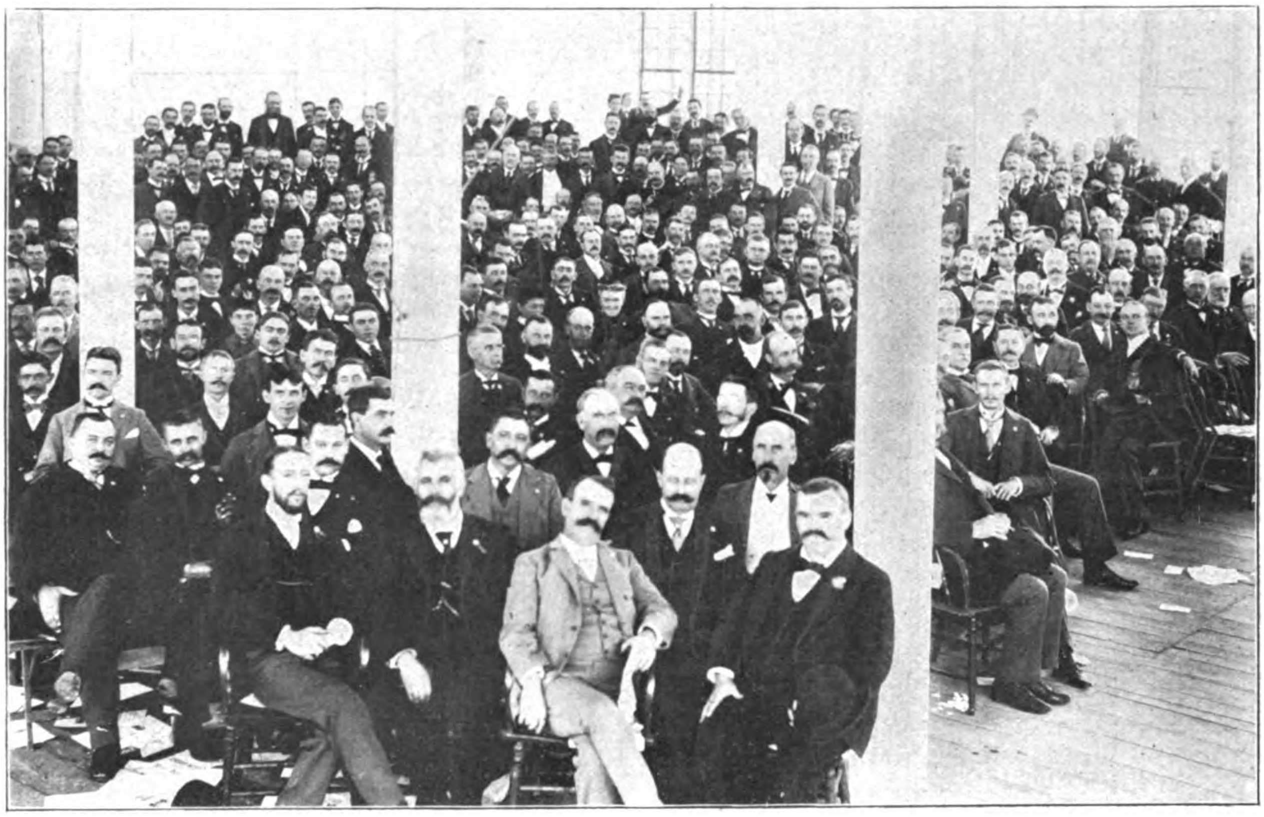
ELECTRICAL INDUSTRIES.

Vol. V. CHICAGO. November, 1894. NEW YORK. No. 11.

Some Features of the Convention.

Of the social features of the convention the reception on Wednesday night was one of the most important. It was an elegant affair and said to be one of the best ever given by the club. The club was handsomely decorated throughout and excellent music and refreshments added much to the pleasure of the occasion. The president of the club, Maj. Livingston Mims, made a very happy speech of welcome.

The annual banquet of the Association was held at the Kimball House the evening of the 18th. Over 300 covers were laid and it was admirably served. The banquet began at 9 o'clock, excellent music being furnished by the orchestra. At 11:30 P. M. the speeches began by President H. C. Payne, who introduced J. H. Stedman, who responded in a happy manner. The other speakers of the evening were as follows: Hon. H. E. W. Palmer, who responded to the toast "Atlanta" in a happy manner. The toast, "Our Association," was responded to by C. D: Wyman; "The Streee Car a Factor of Modern Civilization," by Lewis Perrine," "Railroads and the Law," by Capt. Harry Jackson, "The New South" by Hon. L. C. Levy. "The Technical Press" was happily responded to by J. H. McGraw, and "The Local Press" was taken care of by Lucien Knight.



DELEGATES TO THE CONVENTION ASSEMBLED IN CONVENTION HALL.

The delegates were treated to what was to most of them a novel experience in the way of a genuine Georgia barbecue. It was held at Ponce de Leon Springs, one of the prominent pleasure resorts of the city. The occasion was thoroughly enjoyed by those who were present.

The occasion of the convention was turned to account so far as possible by those in attendance, both from the east and west in making the most of the trip for sight seeing. The special parties that went by the different routes all apparently had an enjoyable time. One of the special trains from New York was run in two sections and everything passed off very pleasantly. From the west, delegates took their choice of various routes. Probably one of the pleasantest trips chosen was that by a small party who went via the Monon route to Louisville, thence over the Louisville & Nashville R. R. to Chattanooga, thence over the Nashville, Chattanooga & St. Louis Railway to Atlanta. Mr. Geo. L. Cross, the northwestern passenger agent of the Louisville & Nashville Railway, made arrangements so that the party stopped over at Mammoth Cave and enjoyed a half day in exploring that one of America's greatest wonders. On the return trip the party stopped over at Chattanooga, spending a half day in visiting Lookout Mountain, Mission Ridge and other points of interest in and about the city. Thence the party returned over the L. & N. and the Chicago & Eastern Illinois Railroads.

The Alternating Current—Its Generation and Distribution.—II.

BY PROF. GEO. D. SHEPARDSON.

A number of simple experiments may be performed which will indicate some of the differences between the alternating and continuous current. For these experiments it will be presumed that we have at our disposal a source of continuous current and a source of alternating current, each having a potential of 50 or 100 volts; 10 or more 50 or 100-volt incandescent lamps which may be connected to either circuit; a coil of 50 or more turns of wire large enough to carry the current for all the incandescent lamps; a bundle of iron wires and a piece of solid iron which may be used as cores for the coil of wire; a second coil having 50 or more turns of wire of any convenient size; a telephone receiver; a jack knife and a pocket compass.

Connect the incandescent lamps to the source of continuous current so that all are lighted. If the circuit is broken at some convenient place, a spark will be noticed at that point. Repeat this operation a number of times, and it will be noticed that the spark is always of the same size, provided that the wires at the point of separation are pulled apart at about the same speed each time. Now change over both terminals of the lamp circuit from the continuous to the alternating current circuit. Break the circuit at some convenient point as before, repeating the operation a number of times. It will be noted that sometimes the spark is about the same size as that of the direct current. At other times it will seem slightly larger, then very small or will even disappear entirely. This indicates that the strength of the continuous current is constant from instant to instant, while the strength of the alternating current is changing.

Connect the coil of large wire into the circuit so that all the current for the lamps passes through it, and switch on the continuous current. If the blade of the jack-knife is opened and pushed down into the center of the coil and then withdrawn, it will be found to be magnetized. Bring the end of the knife near the pocket compass and it will strongly attract one end of the compass needle, but will strongly repel the other end of the needle. Repeat the operation a number of times, being careful to put the same end of the knife into the coil each time. It will be found that the same end of the knife always attracts the same end of the needle. Now put the other end of the knife into the coil and present it to the compass needle. It attracts the end of the needle which it repelled before, showing that the direction of its magnetism has been reversed. Repeat this operation a number of times and the same result always follows. Now place the knife in the coil and break the circuit, while the knife is still in the coil. The magnetization will be found to be the same as before.

Try the same experiments with the alternating current, at first putting the point of the knife into the coil as before and afterward presenting it to the compass needle. Sometimes the knife attracts one end of the needle and sometimes the other. At one time it will attract it very strongly and at another time but feebly. In each case, however, the attraction is much weaker than when the direct current was used. Now break the circuit while the knife is still in the coil, then bring the point of the knife near the compass needle. Sometimes one end of the needle will be attracted and sometimes the other. Occasionally the attraction will be as strong as it was with the direct current; at other times it will be quite weak. This shows that the alternating current is sometimes in one direction and sometimes in the other, as its name indicates.

If the bundle of iron wires is held in the hand and brought near the coil while the alternating current is passing, it will be drawn towards the center. The iron will tremble and make more or less of a singing noise. If the same operation is repeated when a direct current is passing through the coil, the iron core will be attracted, but it will not tremble or sing. It will make a slight noise when the current first passes into the coil and also when the current stops.

Place part of the wire which carries current to the lamps, so that it runs north and south. Place the pocket compass under or over the wire, leveling it so that the neeedle is free to move. When the lamps are lit by the direct current, the compass needle will be moved from its north and south position toward an east and west position. The angle of deflection will vary with the number of lamps in circuit. Now send the alternating current through the lamps and it will be found that the compass needle is not affected by the alternating current.

A galvanometer is an instrument having a magnetic needle suspended by a silk fibre or by some other means so that the needle may be moved or rotated by a very slight force. The needle is generally held in its "zero" position by the attraction of the earth's magnetism. One or more coils of wire are placed near the needle and in such a position that their magnetizing effect is east and west. If the coils are correctly placed, and the needle is at rest before current passes through the coils, a continuous current will deflect the needle equal amounts in opposite directions when the current is reversed. An alternating current would not move the needle at all. If the plane of the coils is not exactly in the magnetic meridian, the continuous current will deflect the needle further on one side than on the other. In this case the alternating current will deflect the galvanometer.

The continuous current may be measured by instruments in which part or all of the current passes through a coil that can rotate in the field of a permanent magnet. If an alternating current be sent through such an instrument, the coil is not affected. The instrument shows no alternating current whatever, although many amperes may be passing. With a d'Arsonval galvanometer in which the coil has a sensitive suspension, the alternating current will hold the coil on one side or the other accordingly as it may be given a start by hand or any other means.

Continuous current is often measured by instruments in which an iron core is attracted into a coil of wire. An alternating current sent through such an instrument would be indicated to some extent, but the instrument would always read too low, unless the iron core was very soft and small or composed of thin sheets or wires.

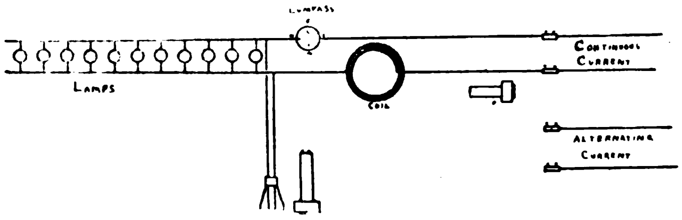
Instruments such as the Siemens electro-dynamometer or Thomson balance, which measure current by the attraction or repulsion of coils, will measure alternating or continuous currents equally well if the coils are not wound on solid metallic spools and if no large masses of metal are near. The coils of such instruments must not have very many turns of wire or they will introduce complications when used for alternating currents.

Connect a coil of wire in series with the incandescent lamps as before and bring near it a second coil whose terminals are attached to the telephone. If the lamps are lighted by alternating current a loud sound will be heard in the telephone at all times. The loudness of sound will vary with the position of the coil. If the current is continuous, the telephone will be comparatively quiet except when the coil is being moved or when the current through the lamps is stopped or started. The small sound that is heard continually is due to the fact that the so-called continuous current is not perfectly continous, but is more or less pulsating when obtained from a dynamo.

If a bundle of iron wires or a bar of iron is passed through both of the coils, the noise in the telephone is greatly increased, whether the current is continous or alternating.

If a solid bar of iron be placed in the coil when an alternating current is passing, it will soon become warm and finally be uncomfortably hot. This effect is not produced at all with the direct current.

If the coil of wire is wound on a metallic spool, such as tin, brass or copper, the spool will become heated much more with an alternating current than with a direct current, unless the spool is slit lengthwise, that is, in the direction across the wires.



A person looking at an incandescent lamp would ordinarily be unable to tell whether it was being lighted by continuous or alternating current. Take a telephone receiver without any wires connected to its terminals. Hold this in different positions near an incandescent lamp. So long as the telephone is held in any one position, no sound will be heard if the lamp is lighted by continuous current. A sound may be heard at the instant the current is turned on or off, but not at other times. If, however, the lamp is lighted by alternating current, a slight humming noise may be heard in the telephone. This noise may be made more distinct if two wires are connected to the terminals of the telephone. Whenever the ends of the two wires are brought together or separated, a sharp click will be heard in the telephone. If the end of the wires are rubbed together lightly, a rough grating sound will be heard in the telephone. Such sounds are not heard if the lamp is lighted by continuous current.

If the telephone is brought near the wire when an alternating current is passing, it will give a buzzing sound. If the telephone is connected to a coil which is near the wire, a much louder sound is heard. This scheme may be developed for locating a wire that is buried in a wall or inaccessible for any other reason. No such effect is produced in the telephone if the current in the wire is continuous.

The student soon discovers that Ohm's law apparently does not always hold true. With continuous currents it is always true that the current equals the electromotive force divided by the resistance, or amperes equal volts divided by ohms. If the circuit contains a number of resistances or a number of electromotive forces, their combined values must be used in the calculations.

With alternating currents there are usually a number of electromotive forces which are difficult for a beginner to account for. For example, the primary coil of a certain transformer has a resistance of 22 ohms. When this is connected to the primary wires between which there is an alternating difference of potential of 1,000 volts, one would expect a current of over 45 amperes to pass. As a matter of fact less than half an ampere passes. Such a coil may safely be connected across a circuit with 1,000 volts alternating, but it would be melted if subjected to 1,000 volts continuous.

The above are only a few of many experiments that might be tried to show differences between continuous and alternating currents. Others mights be performed with more elaborate apparatus, but these are sufficient to indicate that the action of the alternating current may be very different from that of the continuous current. The actions are complicated and require extended use of higher mathematics for their complete explanation. Something can be done toward understanding the subject, without being acquainted with any mathematics higher than common school arithmetic. One may accept on faith the results reached by the higher mathematics in some cases until he can verify them later by himself. Before proceeding to the mathematical discussion of the interesting phenomena of alternating currents, it will be well to consider them from a physical standpoint.

We will first consider the methods of generating alternating currents.

CORRECTION!—On page 303 of the October issue, the first part of the example should read: "The loss of potential on the line will be amperes multiplied by ohms, or, $e=10\times1=10$ volts. The number of watts lost is amperes multiplied by valts or $w=Ce=10\times10=100$ watts."

Plain City, Ohio, Electric Lighting Plant.

Something like two years ago two or three members of the city council of the city of Plain City, Ohio, recognizing the advantages of electric light, commenced in that city to agitate the question of the city owning such a plant. It was thought that a plant of a size such as the city would require could be operated very economically in connection with the water works plant. Considerable opposition was met by these members of the council and it was only after two years of hard work that they succeeded in getting a majority of the council who were in favor of the city owning the plant.

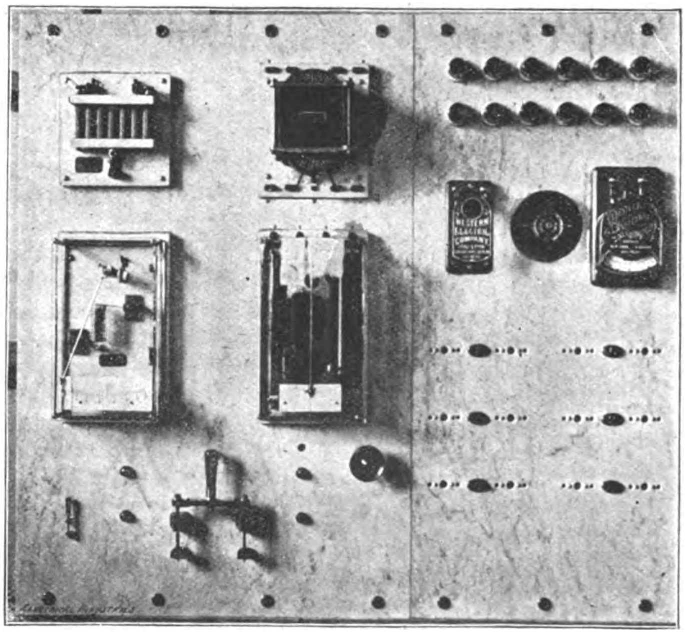


FIG. 1.—PLAIN CITY, OHIO, ELECTRIC LIGHTING PLANT.

The council then proceeded in a business-like manner to secure a plant. The contract for the building was let to local parties and that for the station equipment to the Western Electric Company. The plant was to have a capacity of 40 arc and 750 incandescent lights. Sufficient boiler and engine capacity was also to be provided for and the necessary feeders and line construction. Twenty-nine arc lamps were located about the town. Thirty-five foot poles were erected at the street intersections and the lamps suspended over the center of the street. But few stores are as yet furnished with arc lamps, but it is the intention to supply as much commercial lighting as is desired. There are about 500 16 candle-power incandescent lamps in use from which the city receives a considerable revenue. The number of customers is increasing and it is expected that the income from the commercial lighting will almost pay for operating the plant. While the plant is not large in size some advantage is gained from the connection with the water works system. The labor required is divided, the fuel purchased in larger quantities and the expense of supervision greetly reduced. It is expected at the close of the year a very fair showing will be made.

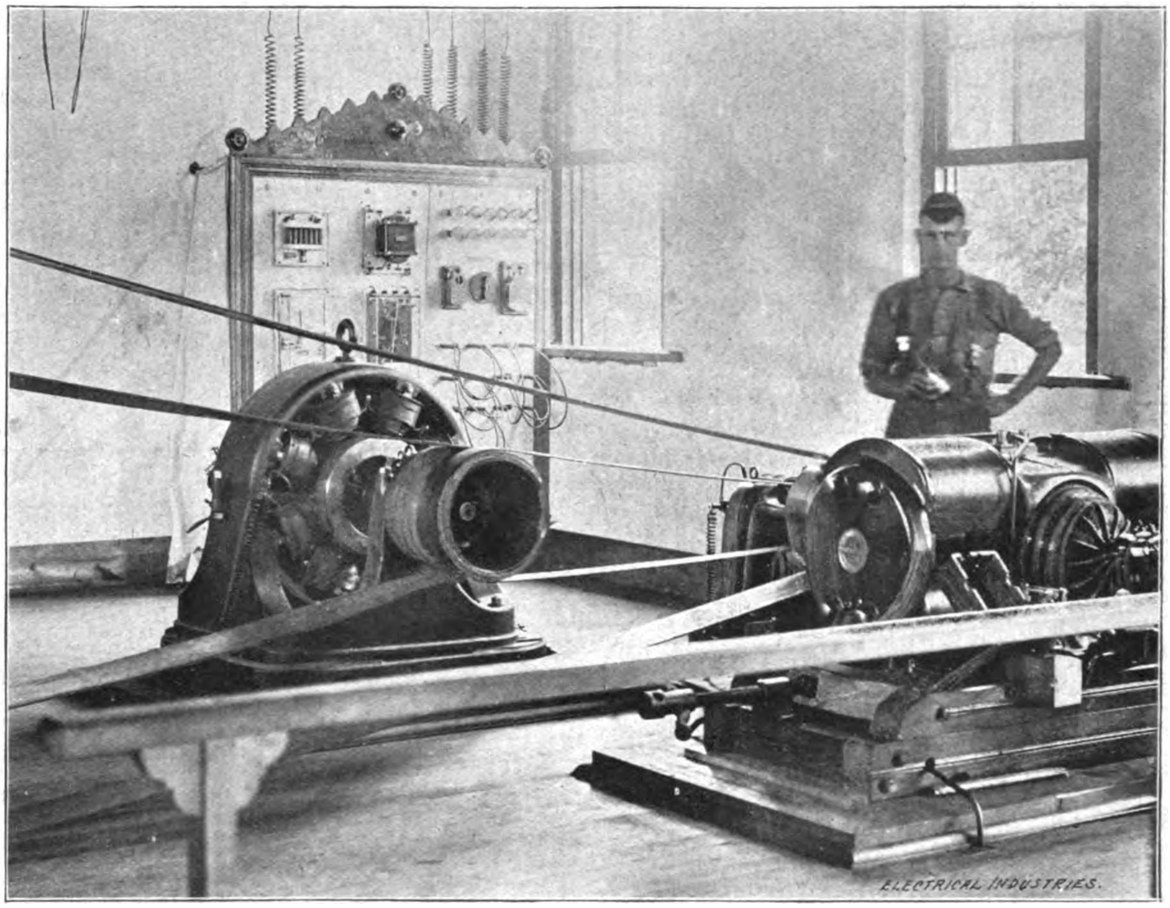


FIG. 2.—PLAIN CITY, OHIO, ELECTRIC LIGHTING PLANT.

The steam plant of the station consists of two 80-horse power tubular boilers and two 80-horse power Russell engines, which were furnished and installed by the Russell Engine Co. of Massillon, Ohio. These engines are set one on each side of the room and are connected to a counter shaft which runs between them. Either or both the engines can thus be used. The dynamos are belted to friction clutch pulleys on this shaft. The dynamos now in use are a 40 light arc of Western Electric manufacture and a 750 light slow speed, low alternation Westinghouse composite wound alternator.

This arc machine is one of the regular arc machines made by this company. It has the latest improvements; is automatic in action, permitting of a change of load through wide ranges without undue heating or excess of sparking. Of the constant current type, the lamps are operated in series. The bearings and lubricating devices are of an improved form. The brushes are carbon, which does not wear the commutator and reduces the sparking. The automatic regulator is one of the most ingeniously constructed parts of the machine. It is at all times connected with the machine and corrects variations as low as one-fourth ampere. The regulation is effected by shifting the position of the brushes around the commutator as the load changes. The regulator is strong, simple and durable, and positive in its action. The dynamo is mounted upon a movable sliding base by means of which the belt can always be kept at the right tension and which also insulates the machine from the floor.

The arc lamps in use are also of Western Electric manufacture and are of the latest type. The switchboard shown in Fig. 1 is made of Tennessee marble and contains everything necessary for the operation of the plant. It was designed especially for this plant. It is divided into panels, that on the right being used for the arc instruments and connections, and that on the left for the alternating current dynamo. On the first is an ammeter, polarity indicator, the necessary spring jacks, ground detector and switches for the arc dynamo, and on the latter, an ammeter, voltmeter, lightning arrester, rheostat, ground detector and main switches for the alternator.

The entire electrical equipment of this plant was installed complete by the Western Electric Company and put in perfect operation before being turned over to the city. The plant has now been in operation several months. It is operated under the direction of Mr. George Kilsbury, superintendent, and H. F. Killen chief engineer, who report to an electric light committee which is appointed by the city council. Reports are made by this committee at each regular meeting of the council so that every transaction in the operation of the plant is reported to the council.

The Thirteenth Annual Convention of the American Street Railway Association.

The first session of the annual convention was held October 17 in the auditorium prepared in Machinery Hall, Atlanta, Ga. The Hon. W J. Northern, governor of Georgia, was introduced by President Payne. In his address of welcome Governor Northern spoke of the beauties and resources of the South and the pleasure it gave the people of Georgia in welcoming the delegates to the convention. The address was heartily appreciated and applauded. To this address President Payne responded, acknowledging on behalf of the association the welcome given its members. Several letters of regret at their inability to be present were read from members and individuals. The reading of the minutes came next in the order of business, which were approved. The following is an abstract of the president's address:

"Gentlemen of the Association: For your partiality in electing me to the office of president of the association, I desire to return my most heartfelt thanks.

"It is hardly necessary for me to say that since our last meeting the street railway business has suffered in common with all other enterprises, owing to the financial stringency and business depression which has prevailed in all parts of the country. These conditions, however, have not been without lasting benefit to the interests which we represent. I presume it is the common experience of all that we are on the up grade, and I confidently anticipate a slow but gradual return to normal business conditions. The resources and characteristics of the American people are such that they cannot long continue in a state of either mental or financial depression.

"During the transition period from animal to electric power on the tramways of our country, it was but natural that the proceedings of the annual meetings of the association should be largely taken up with the consideration of the application of electricity to transportation purposes. Now that we may fairly consider such application as an accomplished fact, I think our attention should to a greater degree be turned to a comparison of views regarding the practical operation of our several roads. The substitution of electricity for animal power has elevated the business to a higher plane. Street railways have become as essential to the prosperity of our metropolitan cities as the steam railways to the country at large.

"Having had practical experience in the management of both these methods of transportation, I can fairly say that the duties of the manager of a street railway equipped for rapid transit are more vexatious than, and require quite as much ability, intelligence and application as, those of one in charge of a steam railway. The steam railway manager makes his time tables, publishes them, and the people are expected to and do suit their convenience to the same. Not so with us. We are expected to make our time tables to conform to the convenience of each individual separate passenger who desires to be transported, and a car is expected to be at each and every corner at the identical moment when the passenger is ready to be carried.

"Again, the steam railway manager has to encounter legislatures and legislation but once in two years, or, at the most, once in each year, and that during a short period in the winter only, while the life of the street railway manager is made unhappy, to say the least, by the legislative bodies in cities, which are practically in continuous session.

"The American capitalist is quick to discover promising fields for the investment of capital, and I think it is safe to say that never in the history of our country has there been a more rapid development than has come from the application of electricity to transportation purposes. In the anxiety to secure franchises and to reconstruct street railways very excessive valuations have been placed upon and paid for the right to operate by electricity in our large cities. This has led the representatives of the people to believe that there is a present value attached to franchises far beyond that which the facts will sustain. Consequently, these conditions have led to a fruitful field for the legislator, as well as for the assessor, from whose tender solicitude for the welfare of the people the street railways,whose prosperity contributes so much to the general good, have suffered. The interest as well as the inclination of most managers tends toward giving as liberal and good a service to the public as the patronage will justify."

He referred in fitting terms to the loss the association had sustained in the deaths of Mr. Wm. Richardson and Mr. Wm. J. Stephenson, who had for years been prominently identified with the work of the association.

In the report of the executive committee that followed mention was made of the business of the past year, the bad conditions generally, and more recently the encouraging signs of improvement. The changes in the membership of the association were noticed, and a list of the judicial decisions published during the year was given. The second volume of "American Street Railway Decisions" was promised to subscribers during the coming month. Two amendments were proposed, one to the constitution and the other to the by-laws. The proposed amendment to the constitution is to provide for the admission of individuals and companies (not street railways) as associate members. The proposed amendment to the by-laws has in view morning sessions only at the conventions, giving the afternoons up to an examination of the exhibits and social features.

The report of the treasurer showed receipts for the year amounting to $8,290.79, and expenses for the same time of $8,196.72, leaving a balance of $94.07. The first report to the convention was presented by Mr. P. M. Dyer, claim agent of the West Chicago Street Railway Company, who was the committee on "The Best Method of Treating Accidents." The report covered in a general manner the method of handling accidents on the North and West Chicago Street railways, which carried during 1893 167,000,000 passengers. One claim department does the work for the two roads, and reports to the general counsels of the two companies. The report was followed by an interesting discussion which was participated in by a large number.

The next report was that of Mr. H. I. Bettis on "A Standard Form of Street Railway Accounts." In this report the need of a standard form was first presented. The essential features of these forms were then discussed. A classification of railway accounts was presented. Upon the conclusion of the reading of the report Mr. Perrine, of Trenton, moved that the paper be accepted and printed, and that the new arrangement of accounts be adopted by the association, and also that a copy be mailed to the auditor and treasurer of every street railway. This motion was carried. After a short discussion of the report the secretary announced that upon the adjournment of the meeting the convention would inspect the exhibits; at 4 o'clock a visit would be made to the car-house of the Atlanta Consolidated Street Railway, and that from 6 until 9 a reception would be tendered to the delegates and ladies attending at the Capitol City Club. The meeting was then adjourned.

THURSDAY'S SESSION.

Thursday morning was taken up by an executive session, at which the subject of transfers and commutations was discussed. The general opinion of those present was that the privileges should not be extended further than is absolutely necessary. The subject of the formation of a street railway mutual insurance company was also taken up. The incoming officers and executive committee were, upon the motion of Mr. Russell B. Harrison, appointed a committee to report on the subject. Messrs. Littell, Perrine and Connette were appointed a committee to wait upon the officers of the Underwriters' Association of the South, with a view to securing better conditions and rates for the insurance of street railway properties. The executive session was then adjourned.

The report of the committee on "Can the T Rail be Satisfactorily Used on Paved Streets?" was then read, an abstract of which follows:

CAN THE T RAIL BE SATISFACTORILY USED ON PAVED STREETS?*

BY STRATHEARN HENDRIE.

"The tendency of the larger cities in this country—in fact we might say in all the cities of this country—during the past ten or twelve years has been toward smoother and better paved streets, and the general public, watching the progress of its city officials, has become in many places impatient of the action of the street railway people in maintaining the old forms of rail, which make a ridge on the smooth surface of a first-class modern street in an American city. Our travelers have come home from England and the Continent extolling the grooved rail, and our city officials have in many cases forced either the English grooved rail or its American modification upon the railway companies. No street railway man hankers after the grooved head before he gets it, or enjoys it after he has put it in, and he therefore fights its introduction, demanding to be left alone, as he was, with his center bearing or five inch tram head. What we would show him—and through and beyond him his public—is that he can progress in the direction of their desires for a smooth street, and can give them something even more satisfactory to them than their favorite grooved rail.

"For the street railway man, questions of price, joints, quick delivery, competition, coal pile, and construction combine to recommend the T rail. The old argument for the tram head—that the steel paving for the three inches is the cheapest in the end—no longer holds good in these days of good street pavements and rapid transit. Wagon traffic goes where it belongs—on the side of the street. To those who can still use the clean headed, old center bearing rail, we can only say, "You lucky dogs;" to most of us it is lost forever. As a substitute for this, where old grants are being renewed or new ones made, the grooved-headed rail has been in many places hastily, and, we believe, unadvisedly, required. While the suggestion of a T rail, for use in paved streets in cities, is startling to the average citizen, alderman or city engineer, and in most cases impatiently rejected by them, yet we must recollect that the mention of a rail, such as steam roads use, calls up in their minds, the idea of four or five inches of steel standing up above the street and of dilapidated plank crossings with half drawn spikes, and we should go patiently to work to teach them, that as there is more than one way to supply motive power to a car, so there is more than one way of putting a rail in the street.

"Modern street railway construction and street paving imply a broken stone, concrete or other solid foundation, a high girder or T rail and a brick, asphalt or granite surface to the street in the larger cities, or cedar block, cobble or macadam in the smaller ones.

"Asphalt or macadam can be paved as easily to a T rail as to any other. They should be laid flush, and room should be made for the flange by running a railroad freight car, or other car having a larger flange than the street car, over the track before it is opened for traffic. Bricks are now moulded by many paving-brick manufacturers to fit girder and T rails, those for the latter allowing a space for the flange of the car wheel. Whether it is more expensive to chip the corners of granite or Medina blocks or to leave them intact a short distance from the head of the rail and fill the space thus made with asphalt, creosoted wood or concrete, is open to question, but, in either case a first-class job can be made. The writer is familiar with two excellent pieces of fifty-six pound T rail construction on chairs, in one of which the pavement consists of six-inch cedar blocks, and in the other of small three or four-inch cobble stones, both paved close to the rail with no filling."

Messrs. McLean, Connette, McNamara, Baumhoff, Bean and Pugh were appointed a committee to nominate officers and select a place for the next meeting. Letters of invitation, from Cincinnati, O., Philadelphia, Pa., and Montreal, inviting the association to hold its next annual convention in their respective cities were read by the secretary.

FRIDAY'S SESSION.

The first business of Friday morning was the report of the committee on "City and Suburban Electric Railways." This report, which was presented by Mr. E. C. Foster, reviewed the present conditions and future improvements in such roads. "It is difficult" the report says "to make the destinction between city roads and suburban roads. The function of nearly all city roads is largely to convey the people from the residential districts, mainly in the suburbs, to the business sections, and likewise, from the latter to the former. In the improvements it has made in this class of transportation, lie the greatest benefits of the application of electricity to street car propulsion. That the electric railway has done much for humanity in enabling the working population to leave these homes in the congested districts and procure more comfortable and respectable ones in the suburbs, goes without saying."

"Next to this most important use of the electric railways comes their use in furnishing recreation for the masses of the people." Reference is made to the tracts of land secured for public parks in the various cities and the facilities afforded by the electric railways for reaching these outing places.

The report mentions the things to be considered in projecting a road, its construction and operation. In its equipment the committee favor the longest cars that can be operated successfully on four wheels for ordinary conditions and for long distances thirty foot bodies on double trucks. Modern multipolar single reduction motors are the only ones that should be used in which great improvements have been made in the past two years. Fares and transfers on suburban lines are considered in the report. Regarding the future of these lines the committee takes a very hopeful view.

"Suburban roads work at a disadvantage compared with city roads, when the question of operating expense is considered. There are many reasons why a given number of cars can be operated for less money, within a small territory than when spread over a large area. These reasons are obvious. In the former case a large number of cars may be cared for in one car house, thus allowing a minimum expense of maintenance. A small car house cannot afford the motor tables, traveling cranes, etc., that do so much to lessen the cost of motor and truck repair, nor can the work of the small house be divided among different men, giving each his specialty, as in a large house. In one of the largest car houses in the world, the Lenox Street house of the West End Street Railway Company, of Boston, two men fill all grease cups, examine and replace brushes, and inspect other parts of the motors of from one hundred and twenty to one hundred and fifty cars, daily. The other work in this house is divided up among some twenty men, including carpenters and blacksmiths, so that the average is about six cars per man. This number of cars per man is often assigned, but probably the work is seldom so well done as in this house. Another important disadvantage under which the suburban road labors is that of the high cost of power. It usually is dependent upon a number of small stations, due to the fact that it is impossible to cover the necessary territory from one station, and both the labor and coal consumption of small stations are necessarily greater per car mile than are those of large ones. The opportunities of making the expense in the first instance, that of car house work, compare favorably in the small house with the large, are rather few. They lie in the dependence upon one capable man, circulating among the houses, directing the efforts of lower priced labor. Another idea that suggest itself is the equipping of one house with a complete outfit of labor saving appliances and bringing all unusual repairs to this house. This is objectionable, however, in that it requires the moving of cars over long distances, at a time when they are least in condition; and, further, that it makes two gangs of men responsible for the care of the cars. Regarding the elimination of the difference in power costs, now existing in favor of the city road, the indications are that the time is coming when it will be no longer necessary for the country road to maintain its numerous steam plants. I refer to the probable introduction of the alternating system of long distance electrical transmission into railway work."

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*Abstract.

THE T-RAIL TRACK CONSTRUCTION OF THE TERRE HAUTE ELECTRIC RAILWAY.*

BY RUSSELL B. HARRISON.

It gives me pleasure to respond to the request and invitation of the American Street Railway Association, extended last year at the Milwaukee convention, to make a report at the Atlanta convention, on "The T-Rail Track Construction of the Terre Haute Electric Railway." Terre Haute is an anomaly among the cities of this country, on the subject of street railway track construction. It is the only city that would not permit girder or grooved rail in its streets, and would make as great a fuss now on the subject, as the average city would do, if an attempt were made to made to lay T-rail track. Our motto has been, not how cheaply, but how well we could construct our tracks in the streets. The public have appreciated our efforts and sustained us loyally.

There has been in the past too much attention paid to motors, generators, cars, power-houses, etc., and too little to the foundation for successful and economical operation—a perfect track. The development of electricity as a motive power for street railway service was very rapid, and it is only natural that the inexperienced should be misled in their hurry to change power and have an electric road that would make them very rich in a year or two. Is it any wonder, then, that many roads should find after a year or two of experience that the tracks were too light for the cars and motors, and the cars and motors were too heavy for the track, and that both were worn out and required rebuilding, at a time when the great panic had reduced traffic to its lowest point. Light and abused track and wornout cars and motors, coupled with reduced traffic, have brought to too many roads the unwelcome guest—the receiver.

The Terre Haute road has indeed had a fortunate experience. Its management early realized, that successful track construction should approach as far as possible, and not deviate from, further than necessary, the best steam railway track construction. So, today, the Terre Haute road is an all T railroad, and every block of track in paved streets of so durable a character that it will last for years, with a minimum of repairs. Terre Haute, although a small town at the close of the great civil war, was very enterprising and determined to have a street railway. A company was incorporated for this purpose in 1866, with ample capital, and commenced to lay track early the following year. The first T rail laid by the company was on South Third street, in the fall of 1890. This rail was laid preparatory to changing the motive power from horse to electricity.

A description of the laying of this first T-rail track will prove of interest. It was a forty pound T-rail, laid on oak ties, 5x7x7, with three feet space from center to center. The rails were laid without proper regard to having the end of the rail rest on a tie. Planks, 2x6x12, were laid on both sides of the rail. On the inside the planks were nailed to the ties, and on the outside blocks were nailed to the ties to raise the plank to a level with the rail, to provide vehicles an easy crossing. Ordinary flat splice bars were used with the rails. The rails were bonded with three-eighths inch galvanized bond wire, with a single bond to the joint. They, in turn, were wired and soldered to a supplementary wire, of one-quarter inch, galvanized, stranded iron wire, each alternate joint being soldered and wired from both rails of the track. In the single track, the supplementary wire was in the center of the track, and in the double track between the tracks. The track was covered in with good gravel.

One year's experience demonstrated that planking was unnecessary; that gravel which is found in great abundance under and about Terre Haute, made—with a little clay that is found above it—a superior substitute for the plank, and protected the rails better, in enabling vehicles to pass along, and to cross the track easily and without injury. This substitute only required occasional attention in filling up low spots to maintain a level roadway. In two years, the planks were badly decayed and warped up at the end, and as the track was thoroughly overhauled at that time, the planking was taken up and gravel substituted.

At the end of two years' service of the track, it was found, in making repairs, that the galvanized iron, supplementary ground wire was rusted out and gone for various distances, making a return circuit an impossibility, and as we only had the rails to depend upon, which, in themselves, for this purpose, are not sufficient, this trouble not only reduced the efficiency of the circuit, but caused frequent burnouts of the armatures and fields. It grew to such an extent that it was found necessary to re-bond this track, and it was decided, at the same time, to dig up and repair the entire track, and increase the number of ties by one-third, and, at the same time, give careful attention to having the ties under and properly supporting the rail joints. Tinned No. 00 copper wire was substituted for iron as the bond and supplementary wire. Good gravel, with a little clay, was substituted for the plank along the rail, and the substitute has given very much better service than the planks have ever done. This section of the road, as rebuilt, is in daily use now, and giving good service.

The era of street paving did not set in, in Terre Haute, until 1892. This was not because Terre Haute lacked in enterprise and progressiveness, but was because the town was situated on a high bluff, fronting the Wabash river, and had, with the gravel subsoil, good drainage and good streets. When it was decided to pave Wabash Avenue and Main Street with brick for fifteen blocks, it became necessary for the company to take up its girder rail. Our experience, thus far, with T rail, had been so satisfactory that it was decided to continue its use on the following method:

Rail.—About this time the Illinois Steel Company brought out their sixty-pound Shanghai T rail, and as it was five and three-quarters inches high, permitting paving without chairs and direct spiking of the rail to the ties, it was very promptly adopted and ordered.

Ties.—Carefully selected oak ties 5x7x7 were used.

Foundation.—After excavating for the track, the ground was rolled by a heavy fourteen ton steam road roller. Then six inches of broken stone was placed in position as a bed, and rolled by the fourteen ton steam road roller.

Track.—Then the ties and rails were placed in position and raised to grade by tamping screened broken stone underneath; spaces between ties were filled with broken stone and rammed into position.

Bonding.—Single bonds were used of seven-sixteenths inch galvanized iron wire, and a supplementary wire of No. 00 tinned copper wire.

Paving.—On top of the broken stone, screened sharp sand was placed, and with one-inch hose this sand was washed into the interstices of the stone. After drying, the sand was brought up to an even surface by a fresh deposit, and it was then smoothed to even surface and the desired thickness by a mould board. Then vitrified bricks were placed in position, leaving them somewhat higher than the rail. They were driven into the cushion of sand by means of hand rammers, with a square piece of boiler plate placed on top of them, to force all to the proper level. The sand cushion permitted the bricks to crown evenly from center towards each rail to afford proper drainage. A special brick with one corner cut off with sloping angle to give space for flange of wheel to run in, was laid next to the rail. These bricks were not the shape of the special nose brick now used, and only set against the lower edge of the inside of head of rail. The space between the brick and web of rail was filled with grouting. Bricks of regular size were laid between. After the bricks had been rammed and rolled to proper position, a grout of best screened sharp sand and Portland cement with water, made to such flowing consistency as to percolate all the crevices, was poured over them, and by brooms pushed into the openings. When thus wet, the bricks were solidly united and they cannot be separated, except with great difficulty. A finishing coat of sand was thrown over the entire surface, and traffic kept off for one week. Vehicles, carriages and wagons can pass along the rail, and turn in or out at will, without jar or wrenching. It can be crossed at right angles, or at any angle with equal ease and comfort. A continuous traffic over it has caused no perceptible wear, and the cars glide over it without oscillation, as smoothly as when first laid.

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*Abstract.

Our next experience with T rail construction was in a street paved with asphalt, where a half mile was laid in the fall of 1892, and a mile more in the spring of 1893.

While asphalt presented some new problems, the T rail, ties, joint plates, bonding and supplementary wire were the same as on Wabash Ave., the foundation was improved by making it of concrete, six inches below the ties. This broken stone concrete was also placed between the ties, and up to a point to allow space for four inches of asphalt packed into position.

The asphalt was brought up to and in contact with the rail on the outside for the entire distance of half a mile. On the inside of the rail for the first half mile the vitrified brick used on Wabash Ave., with corner cut off on a sloping angle, was used to give flange space, and between the two ends of the brick asphalt was used in the regular way. On the last mile the merits of the Haydenville blocks having been brought to our "attention" it was decided to use them both inside and outside of the rail, and while it makes a smoother finish to the rail than the brick or asphalt, our experience proves that these blocks do not have the wearing qualities of the brick. This track and asphalt paving are beautiful in finish, and of unusual strength and smoothness. It is a genuine pleasure for passengers to ride over this track, for there is no motion perceptible except the forward motion.

While this track, just described, was in every way superior, I gave further study to where additional improvements could be made, causing the following changes: First, to use a heavier rail with wider head: second, to substitute metal glass ties for wood; third, to secure greater rigidity and evenness in rail ends; fourth, a firm and permanent hold on the rails without the use of nuts and bolts; fifth, in paving, a better brick and of such shape as would provide better flange room and contact with the web of the rail. These changes brought us to an all steel T rail track.

Rail.—When the Illinois Steel Company brought out the seventy-two pound Shanghai T rail, which was an improvement both in weight, strength and width of the head of the rail over sixty Shanghai T of the same make, it was immediately adopted as the company's standard, and was used in our latest and best T rail track construction.

Bond and Supplementary Wire.—Iron wire, having proved unserviceable and unsatisfactory, the heaviest copper wire was used in connection with this steel track. Double bond of No. 0000 copper wire were used at each rail joint, one in the upper and one in the lower part of the web of rail. These bonds were soldered and connected to the No. 00 tinned copper supplementary wire, that has been adopted as standard.

Injury to track by vehicles and heavy teaming.—On our track, which is standard guage, four feet eight and a half inches wide, heavily loaded vehicles cannot drive along it and get the benefit of the smooth metallic surface as in the case with girder rails. This condition is a great improvement, and makes a saving in many ways.

First.—It saves an immense amount of money in repairing the injury and wrenching to track, and rapid wear and tear thereto caused by vehicles, and particularly heavily loaded wagons turning in and out and driving along the track.

Second.—It permits a quicker and more frequent car service—which all street railway men know means time and money by giving the cars a clear track.

These are great advantages and will be best appreciated by the managers of the lines in large cities. They can also bear testimony to the large savings effected in the wear and tear.

Telegrams were read from Thomas Lowry, President of the Twin City Railway Company, Minneapolis, and also from the Commercial Clubs of Minneapolis and St. Paul, inviting the association to hold its next meeting in the great convention city of the Northwest—Minneapolis.

M. K. Bowen, Superintendent of the Chicago Street Railway, sent a communication recommending that a committee be appointed to investigate the subject of the validity of patented articles used by street railways.

The matter of the proposed amendments to the constitution and by-laws, to provide for associate members, was then considered. An informal vote was taken as to the advisability of the adoption of the amendments; and it was the unanimous judgment of the members that the amendments should be adopted. Action on the same will be taken at the next annual meeting.

The subject of insurance was then taken up and after a considerable discussion the matter was placed in the hands of a committee composed of Messrs. Harrison of Terre Haute, Dyer of Augusta, Perrine of Trenton, Lusher of Montreal and Baumhoff of St. Louis. The following resolution was offered by Mr. Perrine: That the executive committee is hereby request to take under consideration the question of the enlargement of the field and scope of the association and submit a plan suggesting ways and means therefor at the next meeting of the association.

The nominating committee presented the following report: President, Joel Hurt, Atlanta, Ga.; vice-president, W. Worth Bean, St. Joseph, Mich.; 2d vice-president, John M. Cunningham, Boston, Mass.; 3d vice-president, Russell B. Harrison, Terre Haute, Ind.; secretary and treasurer, William J. Richardson, Brooklyn, N. Y.; executive committee, Henry C. Payne, Milwaukee, Wis.; W. H. Jackson, Nashville, Tenn.; D. G. Hamilton, St. Louis, Mo.; G. C. Cunningham, Montreal, Canada; J. N. Partridge, Brooklyn N. Y., and recommended Montreal, Canada, for the next meeting.

After considerable discussion the report was adopted and the officers declared elected.

The next report called for was:

MAIL, EXPRESS AND FREIGHT SERVICE ON STREET RAILWAY CARS.*

BY RICHARD MCCULLOCH.

In order to ascertain as well as possible how much has already been done, a circular asking for information in regard to mail, express and freight service was sent to every street railroad company in North America. Nine hundred and seventy-eight letters were sent out and four hundred and thirteen replies were received. These replies have been tabulated. As a great many railroads were not heard from, it cannot be assumed that the table is absolutely correct, but it is probable that most of the railroads having such a service answered the circular. Roads which are enumerated as having express or freight services are only those which have this service fully developed. The carrying of packages by conductors of passenger cars was not called express service, but is enumerated in a separate column. From some of the states, notably Pennsylvania, Rhode Island and Massachusetts, it was reported that the transportation of express and freight by street railroads was prohibited by state law, and many of the roads answered that their franchises allowed only the transportation of passengers.

The rate charged on express matter was usually five or ten cents per package, while the freight rates vary from four to ten cents per one hundred pounds. The mail is usually carried either under a direct contract with the Government, or under a sub-contract with a mail contractor. The income from the transportation of the mails varies according to the amount of mail, the number of trips per day, and the length of the haul, from $100 to $1,000 per annum. Sixty-two street railroads are now carrying Uncle Sam's mail, while fifty-eight have Government contracts. Most of these railways are suburban roads or roads joining towns; but the postal authorities realizing the advantage of quick delivery and collection, are now beginning to make arrangements with the large city systems for transportation of the mails from main postoffices to branches and for distribution and collection throughout the city.

Various methods of utilizing street railways for this purpose have been proposed by different local postoffice authorities. In one large western city, in which all the roads are controlled by one company, it was proposed to equip one car of each line with a mail receptacle. At stated times, the carriers along the route were to meet this car and drop into the receptacle all the mail collected by them, which was in turn to be taken from the receptacle as the car passed the main postoffice. This plan, however, did not meet with the approval of the great fathers at Washington, and in consequence was abandoned by the local authorities. Any system of this kind would greatly expedite the collection of mails, but the weak point seems to be that no provision is made for their distribution.

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*Abstract.

The only method of handling a large mail service, in which it is necessary to collect and distribute along the route, and handle it satisfactory both to the patrons of the road and the postoffice department, seems to be in the use of a separate car—an independent mail car in charge of a railway mail clerk. This system is already in use on street railroads in St. Louis, Brooklyn and several other places, and so far as we can learn is giving excellent satisfaction, both to the railway companies and the postoffice authorities. The mail is quickly and promptly handled; the service is regular and certain; great and small quantities of mail may be collected and distributed with equal facility, the residents along the line are greatly accommodated, and no interruption or inconvenience to the passenger traffic need result. The answers to the circulars showed that thirty-five roads are now engaged in the express business, while fifty-five are hauling freight. As a matter of fact, however, few roads through the country are doing a regular freight business, most of the so-called freight services partaking more of the nature of express.

In all street railroad practice, the cardinal point of any service, whether mail, freight or express, must be that it does not interfere in the least with the passenger travel, and this point should always be kept in view in the arrangement of such a service. For this reason we would strongly advocate the use of separate cars, operated by separate motive power and by separate men. In roads between towns, or suburban roads operated on the same plan as a steam railroad, where stops are made only at certain stations, a combination car or a trailer might be used; but in city roads the system of piling trunks and boxes in the passenger cars and on the front platform, and stopping for these to be put on and taken off, is not of the era of the electric railway. Another system more fitted to the mule and the bobtail is the custom, yet in vogue in some places, of receiving small packages for transportation and allowing the conductor to deliver them along the route, stopping the car and forcing the passengers to wait. If the addition of a package service renders necessary such a reduction in the efficiency of the passenger service, it is difficult to perceive the gain in accommodation. A passenger car should carry passengers. It should start and stop for passengers alone, and it should reach the end of the road in the shortest possible time.

In closing, it would perhaps be well to note some of the principal points which, it is hoped, have been brought out in this paper:

1. That a mail service involving collection and distribution is best handled on a separate car, operated on the same plan as a U. S. Railway Mail Car.
2. That it is supposed that a great advantage arising from the transportation of the mails comes from the fact that the road is under the protection of the Government, and thus secure from riots, strikes and blockades.
3. That the most promising opening for an express or freight service is a road running between two towns, or a city road running through well-populated suburbs.
4. That the question, whether or not such a service will pay is entirely a local question, and must be estimated for each road separately, under existing conditions.
5. That there are cases when it would be advisable to operate such a service, independent of the profits, in order to accommodate the patrons of the road and to induce building along the line of the road.
6. That such a service operated upon the ordinary street railroad must not be allowed to interfere in the least with the passenger traffic.
7. That in states having laws prohibiting this service, associations of railway managers should be found to secure favorable legislation.

SPECIAL PAPER ON "THE USE OF THE BOOSTER ON ELECTRIC RAILWAY CIRCUITS."*

BY J. H. VAIL AND S. H. WYNKOOP.

Accurate tests show that the commercial efficiency of the street-railway motor at normal voltage is 78 per cent, while at two-thirds of the normal it is only 52 per cent. We all undoubtedly recognize the fact that the resultant effects of too little copper show up to the non-expert traveling public in slow speed and dimming of lamps; but to the railway company the results *are actual losses*—decreased traffic and increased coal bill, which is the direct opposite of what we desire. In other words, instead of aiming at the greatest receipts for the least expenditure, we are actually getting least receipts for greatest expenditure.

The usual remedy suggested is: use more copper. Very good. But if the owners of the road are already groaning under the weight of the copper mine that has been saddled upon them, together with the cash invested therein; if they live in constant fear that they will be forced to place all feed wires in large cities underground, what then?

Leaving out of this discussion improvement in generating station, car equipment and track, we must look for higher economy to the alteration of our methods of electrical distribution, adopting such as will prove, after careful comparison, to be of least first cost, of reasonably high commercial efficiency, of interchangeability on different divisions of the system and of practically automatic action.

We are in need of a marked advance over present practice in this direction, and must devise some method of distribution that shall give better and more economical service over a large area, and which shall at the same time enable us to reach out from the power station to distances at present inaccessible.

The alternating current system, which has done so much to develop the distribution of electricity for lighting by incandescence, has not yet reached that stage of eminent perfection in motive power service which will warrant us in admitting its value for railway work at the present time.

Another method which might be suggested is one which contemplates the use of motor generators located at intervals along the line and actuated by high tension currents. Such a system must be automatic under all conditions of load and short circuits. working with cool bearings and not requiring careful attendance. This scheme also requires practical development.

The well-known booster system, invented by Mr. W. S. Barstow, and applied by him with great success to the feeders of constant potential electric lighting plants covering large areas, is worthy of our careful investigation, as it promises to offer a practical aid to the economic solution of what may be called the medium long distance electric railway problem.

With direct feeding we can overcome the loss in transmitting energy only by incurring the heavy cost of copper as a first investment. With the booster system, we overcome the loss in transmission by incurring the cost of operation of a machine which shall automatically raise the initial voltage above that of the bus bars by an amount which may exactly equal the drop in potential on the feeder at that instant.

Mr. J. N. Beckley presented a paper on "Transfers on Street Railways," which was read by title only and ordered printed in the proceedings. The paper covers the main points in the present system as used on the larger roads amd emphasizes several features of every well designed transfer slip.

Mr. W. E. Harrington offered a report on the "Destructive Arcing of Five Hundred Volt Fuses," which was also read by title and ordered printed. The subject of this paper is more fully explained by the opening paragraph, which is as follows: "The destructive effects of the arc accompanying the opening of 500 volt circuits with switches, lightning arresters and fuses, has led the writer to inquire into this phenomena, particularly in reference to fuse practice. A series of carefully conducted tests were made to find the relation between the fusing currents of different size copper wires ranging from No. 30

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*Abstract.

to No. 21, B. & S. gauge, the time required to open the circuit, and to what exeent the arc contributed to the time required."

From or as a result of these experiments the author draws the following conclusions: *First*—The proper and only fuse block to be used is one having protected terminals. *Second*—That fuse blocks should be furnished so that the terminals would not be burned under conditions approaching an absolute short circuit across the bus bars of a 500 volt power station. *Third*—That magnetic cut-outs are immeasurably preferable under all circumstances.

One of the important reports made to the convention was that on brake shoes for street railways prepared by D. F. Henry and Powell Evans. The report will undoubtedly prepare the way for improvements in this direction. As recommended by the paper a committee composed of two members of the association and one manufacturer was appointed to investigate the subject of the adoption of a standard style of brake shoes. The following report was read by title only:

POWER-BRAKES VS. HAND-BRAKES.*

BY E. J. WASSEL.

Gentlemen:—Hand-brakes and friction-brakes have not materially changed since the day they were first put in service. It is obvious that a brake only powerful enough to stop a small, slow-moving, light-weight car, has outlived its usefulness when applied to cars weighing seven tons or more, propelled by an unseen force which has driven livestock from the field. The modern brake, when placed alongside of the oldtime brake, bears the same relation to it that an arc light does to a kerosene lamp. Brakes of all kinds are useful, but the brake installed today should answer all the severe requirements of modern practice.

By common consent, the two things regarded as most important in steam railroading are the wheel flange and brake. None of us would like to travel on the Empire State Express if we had to depend on hand-brakes instead of the well known air-brake. It is not strange that car builders have not kept pace with the present requirements, in their breaking apparatus. They have done well for the street railway fraternity, but heads and hands have been occupied in developing trucks, wheels and car bodies, and builders have not been able to do justice to the brake. The radical changes in car building brought about by cable and motor cars, have kept builders busy. They could not devote their entire attention to improved brakes.

We have no controversy with car builders on this question and wish to suggest rather than criticise. If buyers demanded improved brakes, builders would conform. As such demand has not been made, the brake of today remains in appearance substantially what it was twenty years ago! The evolution of the electric motor has been rapid and astonishing. Motor builders have had great odds to contend with, but have overcome them, and the leading types of machines combine efficiency with low cost and economy of operation. Motors have been standardized.

It will not be denied that hand-brakes are inadequate. If power-brakes could be furnished at the same first cost as hand-brakes, they would be universally adopted. The day is approaching when brakes will be considered as separate equipments and will not be quoted in the lump sum named per car. There is no more reason for including brakes in the estimates than for including motors.

On roads free from grades, there is obviously no apparent necessity for reliable brakes as there is on roads which have grades of from five to fourteen per cent, or where travel is congested, and especially on suburban roads operated at high speeds. Cars should be artistic, but they should be equipped with brakes that will do their work quickly when danger impends. On steam roads hand brakes have proved utterly inadequate. They were tested and found wanting. When the first air-brake made its appearance it encountered great opposition. Where would steam railway practice be today if air-brakes were eliminated? The battle of power-brakes vs. hand-brakes on steam roads was fought years ago, and air-brakes remained in possession of the field. It is questionable if the need for power brakes is as great on steam roads as it is on surface roads, especially when trailers are run.

Electric cars in even out of the way places, ascend grades that no mogul engine has to confront. Of course there is a corresponding down grade, and it is here that the difficulty arises, for surface cars ought to stop for passengers no matter how steep the grade or high the speed may be. Otherwise earnings decrease.

The breaking power on an electric car should be so positive as to permit of stopping in less than the car's length if necessary. One has only to watch the men breaking cars going down such grades as exist in Albany and Jamestown, N. Y., Easton and Allentown, Pa., and scores of other places, to have a full appreciation of this point.

Without entering the humane feature of braking, it cannot be denied that at best hand-braking is a great task for even strong men. They report fresh in the mornieg and for a time muscles stand the strain; but after a few hours, handling of a grip-lever or controller-handles they find their strength decreasing. Realizing this, for the rest of the day they slow up earlier than strictly necessary or (as often happens) they do not stop at all and let cars run past crossings, missing passengers, who do not always wait for the next car, but walk instead.

If, however, the men have ready for instant use an ally in the shape of power requiring but the touch of a handle to become available, they are placed in the best possible position to make as many stops in as short a distance as is necessary. Not being fagged out, they are better able to do their company more justice and are more on the alert to prevent accidents.

That practical men have been apt to think too lightly of the question of improved brakes, is explainable by their having so many other important things to oversee. Then, too, the aim of a railway man is to incur as few obligations as possible, and to operate with utmost economy and earn dividends. But often seemingly cheap apparatus proves dearest in the end.

Probably seventy-five per cent of recorded accidents is chargeable to inefficient brakes. Statistics of this sort are hard to tabulate, and some records show even a higher percentage. While hand-brakes often stop cars quickly, they do so by consuming excessive energy. This means waste and increases maintenance account.

Air-brakes are provided with reserve power stored in reservoirs, and, by having large enough capacity, the air pressure required for braking becomes practically inexhaustible. The air pump of a thoroughly good air-brake is most economical in operation. It requires no power when car is starting or when it climbs grade. As it takes ten times the power to start a car that it takes to keep it going, the advantage of this is obvious. A good air-brake is so compact that very little room is required for it under car body. It has no cumbersome or complicated machinery to get out of order. It works automatically. It needs much less attention than an electric motor gets. It is only necessary to keep mechanism clean and in order, and to lubricate pump regularly. No hinges or springs annoy inspectors or employes. A good air-brake pump, the moment it has compressed sufficient air, cuts out and runs in free air with the axle. A good air-brake entirely replaces a hand-brake. The hand-brake may be left on the car, and the air-brake can be so attached as to leave the hand-brake available should it be required. A good air-brake requires no expert to operate it. It is so simple that a child can work it. This being so, a railway manager is not restricted to hiring men of a certain height or weight, for when work is done by compressed air instead of muscular strength, no Samson is required to work the handle.

One type of air-brake equipment in service enables the gripman with but a small handle to work grip and brake either simultaneously or independently. When this type brake is used on car, grip and brake levers are entirely removed, giving more space for passengers on platform. Through its use, what formerly involved painfully hard work, is now accomplished with ease. This device is in successful operation on car 421 of the Third avenue railroad, New York.

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*Abstract.

We believe it is better to keep the motor controller and the brake handle separate, but if railroad men demand a single handle to operate both it can be supplied just as was done in the air-brake on Third avenue, New York, car 421, which works grip and brake. We doubt, however, if a real necessity for a single handle exists.

Recently a new form of power-brake has been announced, in which electricity is relied upon. The electric-brake, while undoubtedly possessing some valuable features, has some which are a decided disadvantage. It is, of course, in its infancy, and the future of the electric-brake will be watched with interest. We saw the paper read by Mr. Sperry on the 19th of last September before the American Institute of Electrical Engineers entitled, "The Electric Brake in Practice." Mr. Sperry, unknown to himself, quotes our language verbatim, which was used as an editorial by one of the dailies and subsequently was copied in the journals. It is to be regretted that, when using a *part* of our matter, the able electrician did not use other parts also.

He says that a locomotive engineer has his pressure guages, which allow him to adjust the brake application to a nicety. A good air-brake for surface roads is also supplied with a pressure guage, but in practice no Westinghouse air brake engineer looks at a guage, and they are more ornamental than necessary. He states that with an electric-brake the brake shoes are entirely dispensed with. Do the street railway men intend to abolish brake shoes? Suppose, as may happen, the electric-brake fails to work, what will become of the car or train? There is an apparent contradiction in the article on this point. In one place it states that the electric-brake does away with brake shoes, and in another place it admits that it will be necessary to resort to hand-brakes. How can hand-brakes be used without shoes, and how can a car be held by an electric-brake after the residual magnetism (or Foucault current) is dissipated? He says that the one grave fault of an air-brake in railway service is that the maximum brake application does not exist as it should at the higher speeds. This is an error. The immense advantage of an air-brake over an electric-brake is the fact that power can be applied in varying degrees; great power when needed and almost imperceptible power if only very slight retardation is wanted.

An air-brake holds the wheels and keeps doing so. An electric brake, after first stop, depends wholly upon residual magnetism. This, at its best, is an uncertain factor. As we understand the paper, the residual magnetism in the electric-brake is only available for something less than one half minute after car has stopped. When this magnetism is consumed the electric-brake possesses no more braking power whatever, until the car is again in motion. It is right here that the air-brake shows its immense superiority, for it has the air-reservoirs to draw upon when car has stopped, and therefore ample power is available for immediate and constant use. This failure in source of supply is a tremendously weak point in an electric-brake. The paper states that "the current flowing after motion ceases, though small (mark this admission) is found exceedingly useful in holding the car from starting itself, even on quite a heavy grade, as only a small quantity of energy, added to the already great friction of quiescence, will prevent the car from starting." We fear that at such times the advocate of electric-brakes would need something more reliable and constant to lean upon. The paper says, "when an electric-brake is used it seems as though the car was running into an air-cushion." This pays a well-merited compliment to air-brakes, for by them an air-cushion stop is made possible. The paper adds "operating the brake in this manner it will at once be seen that the system is one of the utmost certainty of operation, surer even than the hand-brake, air, or other power-brakes." If the speaker had not been for some years in the electric-motor business, he might not take such decided exception to this claim as he does; but since working with air-pressures he has found them much more reliable and safer than electricity. The inventor referred to makes fourteen claims of the advantages of his brake over other brake systems.

There is no part of electric or cable railroading so important as the ability to stop cars quickly and to keep them stopped! This is specially true where electric or cable cars cross steam roads at grade. At such times hand-brakes show their inherent inadequacy.

We do not advocate the adoption of a scientific toy but submit for your consideration the fact that you can procure at comparatively low cost, air-brakes which are positive, simple, economical and highly efficient, and which have been tested in the crucible of daily operation.

In advocating the adoption of air-brakes we are often told by railway men, "We haven't time for experiments. Let somebody else do the experimenting and then we will look into the thing." Had this position been taken by progressive men would there be a single commercial electric motor in existence?

The experimental stage was passed long ago and with 350,000 air-brakes on locomotives, passenger and freight cars, it is untimely to talk about experimenting, for steam roads and surface roads have much in common. If a freight car loaded with pig iron needs an air-brake how much more is one needed to brake a car carrying living beings?.

There are air-brakes and air-brakes. Of the merits of the different ones buyers will do well to satisfy themselves before contracting.

The all-important question is whether the first cost of a good air-brake is too high, or not, in proportion to the advantages gained. No accountant can figure accurately how many dollars of damage claims will be avoided; nor how much revenue will be increased by the quicker schedules made possible with air-brakes (for even seconds counts); not what the gain in labor account will be by not being restricted to hiring any particular height or weight of man; or how much the life of car body, truck and motor will be prolonged. There is a decided gain from whatever point we view the air-brake and with an air-brake an employe is armed at all points.

Will it not be worth your while to give this braking matter earnest attention? If but a few of this audience will determine to investigate the advantages of the air brake over all other forms of brakes, this paper will not have been prepared in vain.

Discussion.—Mr. E. A. Sperry: The paper just read by title contains a reference to a paper read by me before the American Institute of Electrical Engineers last month. The reference being somewhat unjust, I would like the opportunity of showing wherein some of such errors have occurred. My paper contained fourteen points of excellence, in which the electrical brake was superior. These points have been taken up by Mr. Wessels in their order, and remarks attached to each, embodying claims on behalf of the air-brake. For instance, I said that the use of the electric brake, which does not employ brake-shoes in the operation at all, would cause an entire saving in such brake shoes, with a resultant saving of wheels from two to three fold. The author has attached to this the remark that a good air-brake saves wheels. The air-brake is used simply to increase the power of the application of the brake shoes, which, while smeared with sand and dirt, attack the rims of the wheels, "drawing" the chills, and very soon grind off the face of the wheels to a point below the chills, when the wheels will have to be pressed off, and others substituted. The air-brake, instead of saving wheels, simply tends to grind them down sooner by the superior pressure of the shoes upon the wheels, over and above that readily obtainable by hand. With the electric brake the wheels are retarded and brought to rest without the application of brake shoes, and the rolling contact between the wheel and rail, being the only point of wear, the grinding and ruining of the chill is entirely avoided.

Another point referred to by the author is that of the air-brake not causing flat wheels. It will be readily understood that with the electric brake this cannot occur, from the fact that when the wheels stop momentarily, the motor which has been converted into a dynamo also stops, and therefore it cannot generate current with which to further and continuously hold such wheels, and they simply start again to roll slowly, which gives better retardation than while sliding, and therefore cannot be ground flat.

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The convention, last month, of the American Street Railway Association, at Atlanta, adds another to the long list of successful conventions held by the Street Railway Association. As each year shows a greater development of this industry, more experience on the part of those connected with it and a better knowledge of the operation of street railway systems, these annual conventions mark steps in the progress of the industry. This association is gradually becoming an electric street railway association, as each year shows a larger number of electric roads and a smaller number of horse roads. The change from horse to electric power has been especially noticeable during the past year in the large cities where the prejudice against the trolley has been the principal thing which has heretofore prevented its introduction. The electric railway, representing the more modern railway system, enters into the larger part of the discussions of these conventions. The exhibits of cars, trucks and material indicates an even more general adoption of electricity as a motive power. Among the exhibitors this year were noticed a number of new makers of electric street railway apparatus, showing that the capacity and facilities for the production of electrical apparatus in the country is increasing. As a whole the exhibits were numerous and well arranged. They received a fair share of the attention of the association and were beneficial both to the manufacturers and to the railway men. The exhibits of car heaters and improved forms of brakes were special points of interest. Managers have for some time been on the lookout for a brake more modern in design, and therefore take great interest in any appliances of this kind which give promise of supplying the want. The attendance was good and the number from the southern roads was encouraging. It is to be hoped that in the future the companies in the southern cities will take greater interest in the work of the association. The south still offers many opportunities for the investment of capital in street railways in the smaller cities. The reports and papers were up to the usual standard, but many of them were read only by title and the time at the disposal of the convention did not permit much discussion. The need of a change in the programme of the conventions, so that the members may be gotten together more expeditiously and the business transacted in a more efficient manner, is evident. In the amendment proposed to the by-laws a remedy is provided which will undoubtedly make the meetings more efficient and profitable. The social features were greatly enjoyed, as were also the trips through the south taken by the parties from the different northern cities. The members returned with many pleasant recollections of the trip as well as a fund of valuable information.

The papers and reports that were read at the convention were upon well-selected subjects. The subject of accounts as discussed by Mr. Bettis is of importance both to the manager and to the director of the road. While the system of accounting should show clearly the financial condition of the road, it should show also the operating expenses so clearly that the manager is able to find the cost of each item in its operation which should be a constant guide in the management of the road. The T rail received considerable attention, being discussed by the committee and also by Mr. Harrison in his excellent paper on the use of the T rail on the Terre Haute railway. The tendency of recent years has been largely toward girder rails which is due, undoubtedly, to the ideas of the city councils, which insist that the girder rail be used. The excellent methods described in these papers would, if followed, undoubtedly change the present opinion of the city authorities. They are the best rail for the average road as far as the company is concerned but in the construction of such roads much depends upon the character of the roadbed and method of construction. To change the present opinion of our city governments will be hard and difficult work. It is well, however, that the subject was brought so prominently to the attention of the convention as it brings out the special merits of the T rail construction.

The paper read at the convention by Mr. McCulloch on "Mail, Express and Freight Service on Street Railways" shows that this service has grown to much larger dimensions than anyone imagined. The fact that 62 roads are carrying United States mail would indicate that the advantages of the railways in this service are generally appreciated. More elaborate systems are being planned, but have not yet been put in operation. The express and freight service has not been so generally carried out, but it is evident that the advantages that a car mounted on trucks and moved over the superior roadway of the railway for conveying goods from warehouse to freight-house possesses are not generally understood. Where it has been tried the saving in cost of transportation has led to extensions of the systems. For carrying small packages the above paper points out two advantages to the company—the profit from such a service and the encouragement it will give to passenger travel between the city and suburb. The necessity of providing separate cars for this service is well brought out. To be successful the service must in no way interfere with the passenger travel. When it is so conducted, it tends to encourage passenger travel, that for which the road was primarily constructed. In concluding his paper Mr. McCulloch presents a summary of the points he has gathered in a study of this subject.

The special papers contained much that was interesting. The paper on "Brake Shoes" prepared by Powell Evans and D. F. Henry will undoubtedly open the way for some future work in this direction. The steam roads have taken up the matter and are engaged upon experimental work which should ultimately lead to improvements in brakes and car wheels. The brake shoe is of an equal importance or even of more importance on the street railway and should receive a corresponding amount of attention. The renewal of car wheels and brake shoes each year on a street railway amounts to a considerable item. The subject has received little attention heretofore. In fact it has been almost entirely overlooked. Now that it has been brought to the attention of the association no time should be lost in carrying out such of the suggestions offered as it may approve. The advantages of a standard size for brake shoes are generally acknowledged and there are also other parts of the car that might be made from standard patterns. Other suggestions of the authors should be considered and brought up at the next convention. The paper by Mr. E. J. Wessels is on the same line but deals more with the application of the brake. "Power Brakes vs. Hand Brakes," was well discussed and the advantages of the air brake prominently brought out. Some improved form of brake will soon be demanded by the authorities as it is now demanded by the needs of the present systems of electric railways. It is to be regretted that time did not permit these papers to be discussed as they deserved by the association.

THERE is no metal that enters so largely into the construction and operation of electrical installations as copper. Its high conductivity caused its early adoption in electric lighting and power transmission systems, and its use has constantly increased. The present tendency toward larger power stations and systems of transmission promises that the present large annual consumption will be increased. Copper mining has received a great impetus and is looked upon as one of the most substantial of mining industries. Lake copper has been considered the best for electrical uses and had but little competition until the electrolytic process of refining was introduced, which product now commands an equal price with Lake copper. The conductivity of the latter is said to be improved when refined electrolytically. The excellence of this method has made it the favorite among producers. The large refinery (capacity 2,000,000 pounds per month), at Great Falls, Mont., where an abundance of water power is secured at a low cost, produces large quantities. It is said that another large refinery is to be erected at Great Falls in the near future. The refinery at Anaconda, Mont., will, when completed, have a capacity of 50 tons per day. These large plants will have a sufficient capacity to refine the entire output of the mines of this country so that the exportation of any but refined copper will undoubtedly cease. While the demand for copper, on account of the large quantities used for electrical purposes, has increased, the price of the metal has decreased, which is due to the decrease in price of all commodities and also the reduced cost of production. In 1883 when the electrical industries demanded but a small amount of copper, one-half of the copper came from the Lake region. At the present time scarcely one-third comes from that region. In that period the annual production of copper in the United States has increased from 60,000,000 pounds to 330,000,000 pounds, while the copper used in the arts each year is increasing, the production has also increased in a corresponding ratio.

IT is an old saying, and one well followed, that a "stitch in time saves nine." The manager of a central station usually about this time of the year has the lines overhauled and put in the best possible condition to withstand the severe winter weather that will soon reach the northern cities. A new tie here or a joint repaired there, a brace for the cross-arm or a new insulator in place of the broken one, will save many hours of hard work next winter when the fingers are stiff with the cold and the movements of the linemen are impeded by the heavy clothing. Repairs of all kinds are more quickly and easily made at this time of the year. Street railway men usually prepare for the extra work that the winter brings by getting the overhead lines and track in good condition. Break-downs and delays cause not only extra expense and inconvenience to the company, but give cause of complaint to customers and patrons, which is scarcely ever overlooked when accounts are collected or the effort is made to increase the customer's trade. The public demands and expects that its supply of light shall be as constant and more reliable than that of the sun.

IT has frequently been remarked since the incandescent lamp was invented that the day was not far distant when the incandescent lamp could be purchased at the stores, as candles since the days of our grandparents have been purchased. That day has arrived. The store keeper of our smaller towns may not and has not added them to his stock but in the larger cities where the incandescent lamp is almost universally used, especially by business houses, the incandescent lamp forms a part of the stock of the large general stores. In those great commercial institutions where one can buy dress goods and groceries, lumber wagons and toothpicks, diamonds, hardware and coal, have one's hair cut or tooth pulled, get one's shoes shined or have a broken leg mended, one can now purchase incandescent lamps, brackets and electroliers at competition prices. The electrical supply dealer must be on the lookout or he will have to meet on other goods the competition of these dragons which have consolidated under one roof every retail trade. Electricity is no longer "in its infancy." The public understands its value and knows how to use it. Electrical goods are made in standard sizes and can be as readily purchased as any kind of apparatus. The experimental stage has been passed, and a customer may purchase a dynamo or motor with as much confidence as a boiler or engine. While there is opportunity for many improvements along certain lines and we may confidently look for the extension of the present field, yet an isolated plant or a central station may be erected without fear that the machines will became obsolete in a few years. As electrical goods are more readily purchased and are placed under the eyes of the public, their use will become more general.

IN an editorial in the October number of "Dixie" attention is called to the trade possibilities of Mexico and the South American countries, and suggests that manufacturers could best be brought in communication with customers in these countries by means of an international exposition in Mexico. The replies to letters sent out to gain the opinion of manufacturers regarding such a plan show them ready to co-operate in such a movement. The efforts made by this enterprising southern journal are certainly commendable and worthy of attention. Manufacturers of electrical apparatus would in this manner find a means of extending the present field in these countries. The capacity of the companies now engaged in the manufacture of electrical apparatus is probably in excess of the demands of the home market, and it will soon be necessary, if these companies are to find customers for their goods, to look beyond the United States. American goods actively pushed in the markets of South America will secure a footing which will be sufficient to hold them against the competition of European manufacturers. An exhibition of electrical apparatus at an exposition in the city of Mexico would undoubtedly bring the desired results. The movement is timely, and the co-operation of Mexico and other countries will undoubtedly be secured in bringing about one or more industrial expositions. In promoting trade with these countries there are many subjects, such as transportation, duties, etc., which should be discussed, and congresses and such other organizations should be arranged as shall help to bring about the desired end.

The New President of the American Street Railway Association.

Mr. Joel Hurt, the newly elected president of the American Street Railway Association, was born in 1850. The vocation selected, when a youth, was that of a civil engineer, and he entered the University of Georgia to receive his education for that pursuit. In 1871 he graduated and received his degree. For some ten years he followed this calling, being engaged on surveys and construction on the Atlantic & Pacific railroad, the Northwestern and others. He became, in the early '80's, interested in insurance and real estate in Atlanta and has since been prominently connected with the institutions which have built up the city.

His greatest success has been in the railway field for which his early training had given many advantages. In 1891 he was elected president of the Atlanta Consolidated Street Railway Company and at once went to work to bring the different lines under one management. The system is now one of the best in the south. His work and conduct during his residence in Atlanta has won him the confidence and esteem of his fellow citizens.

In the work of the American Street Railway Association, Mr. Hurt has been an active participant. His advice and counsel has been sought and prized by its members. He is a pleasant and agreeable acquaintance, and as president of the association we may confidently look for an extension of its interests and a most successful convention in 1895. For the success of the convention at Atlanta the association is greatly indebted to him.

Earnings of the Binghamton Railroad Co.

The president's report to the Binghamton Railroad Company shows the following relation of receipts, operating expenses, etc., for the year ending September 30th, 1894.

Receipts	$115,931.07
Operating Expenses	66,929.51
	$49,001.56
Interest on Funded Debt	$22,687.50
	$26,314,06
Taxes	$2,951.00
Surplus for stock	$23,363.06

A comparison of the last quarters 1893 and 1894 shows a gain in receipts of $7,220.89 and in operating expenses of only $2,346.11; making the net earnings for the last three months $4,799.28 over those for the same period of 1893. The statement for the two quarters is as follows:

	1893.	1894.
Receipts	$34,688.27	$41,909.16
Operating Expenses.	15,696.93	18,043.04
	$18,991.34	$23,866.12
Taxes	700.00	775.50
	$18,291.34	$23,090.62

The earnings shown above have been made during a period of construction and installation of electric equipment; also paving and sewer building; in consequence the service has been imperfect and irregular, and at times certain portions of the road were necessarily abandoned pending these improvements. The above is the more remarkable when considered with the fact that during the year one of the most important divisions has been operated with horse power.

A stock dividend of 20 per cent was declared during the year by recommendation of the stockholders and by vote of the directors, the same being the surplus earnings which were expended in construction of the road. The stock of the company has sold at par, and the bonds at 101 and interest during the recent panic and since the above dividend was declared.

ODDS AND ENDS.

It is said that the operation of the Douglas & Laxey Electric Railway in the Isle of Man, which was opened this year, has been quite successful. The road is seven miles long, and has had a large patronage from the summer visitors.

On the new electric line running on Wallace street, Chicago, a woman last month attempted suicide by throwing herself in front of a moving car. The motorman, however, saw her in time to stop the car before any serious injury was done. A few bruises where she had been pushed over the track by the car only resulted. This is not a new method of attempting suicide, and it seems strange that so cruel a method should be sought, where bruised flesh and broken bones are received, but not always the desired result.

Among the companies which have recently made contracts with the Niagara Power Company is the Carborundum Company, which has contracted for 1,000 horsepower. In the manufacture of this product the concentrated heat of the electric arc is used. Carborundum, which is a new product but recently invented, takes the place of emery and other abradents, which it excels in many respects. It was invented by Mr. E. G. Acheson, who owns the foreign patents as well as those in the United States.

Two companies are seeking to secure franchises for street railways in the town of Cicero. Almost the same territory is desired by each. The stockholders of the Ogden Street Railway Company, which was incorporated about two years ago, are also interested in the Cicero & Proviso Street Railway Company. This company has franchises for streets granted over a year ago, and the new franchises sought are for extensions of those lines. The Inter-Urban Street Railway Company was incorporated but a short time ago. The president is Mr. O. W. Bruner, and the secretary Mr. D. W. Campbell. A fight is expected between these two companies for the possession of the territory.

It will be of interest to many of our readers to learn that since the close of the World's Columbian Exposition there has been connected with the Imperial German Consulate in Chicago a commercial department, the purpose of which is to stimulate the commercial exchange between the United States and Germany, to facilitate the intercourse between buyers and sellers of merchandise of all kinds—raw material, victuals, machinery, apparatuses and instruments, objects of art, etc.—of America and Germany; to keep both sides posted on the subject of duties, currency, rules for importation and exportation, etc., and to give information about new inventions, patents and new processes of manufacture, and how they can be utilized. Thus, this department is not an agency for a certain number of private firms, but a bureau of general commercial and technical information, which is given free of charge to any American or German firm interested in importation to or exportation from Germany. Its work is limited to collecting and distributing information, and it does not undertake to close business transactions of any kind, nor will it interfere with any business relations already existing between firms of both countries. It is a special department of the Imperial German Consulate in Chicago, and had its origin with the World's Columbian Exposition, after the close of which the establishment of such a bureau proved to be a necessity in order that the consulate might be able to attend in a proper manner to the many inquiries that poured into it from all sides. All communications intended for the department should be addressed to the Imperial German Consulate, Commercial Department, 120–122 E. Randolph street, Chicago, Ill.

The new power-house of the Chicago Electric Traction Company on California avenue is rapidly approaching completion. A large force of men has been at work and the completion of the building hastened as much as possible. The line work has also been carried forward rapidly, and it is expected that early in December a few electric cars at least will be started. The equipment of this power-house will be complete in every respect. Excellent facilities are being made for receiving and handling the fuel, and in the operation of the station the arrangement of the machinery will be such as to afford the best economy.

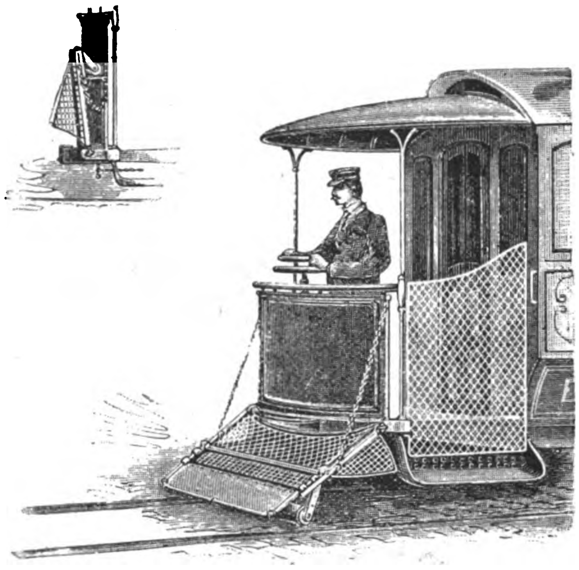
Mount Lowe, Cal., which is already one of the great points of interest for tourists and a resort for the people of the state, is to have another attraction in the shape of a search-light. The large search-light which was mounted on the colonnade at the World's Columbian Exposition and afterwards on the tower at the Midwinter Fair has been secured, and will be mounted on an elevation on Mount Lowe, which already numbers among its attractions a system of mountain railways, an astronomical observatory in charge of Professor Swift, formerly at the Warner Observatory, and such magnificent mountain scenery as has caused it to be called the American Alps. This search-light was made at the works of the General Electric Company, and in this new position where the air is clear it is estimated that its rays can be seen at a distance of 200 miles.

The transformation of the horse lines of the West Chicago Street Railway into electric lines is progressing rapidly. The track work is well under way and much special work, such as demanded by the crossings of the steam roads, etc., is being done. The contract recently let for setting three thousand iron poles will soon be completed by the contractors. The force engaged in constructing the conduit system for the feeders are making good headway on Western Ave., where 48 tubes are being laid. The construction of the manholes involves a large amount of work on account of the nature of the soil which requires deep excavations to secure a foundation. The power house is being erected at the corner of Western Ave. and Washington boulevard. This will contain sterling water tube boilers, Fraser & Chalener engines and Siemens & Halske generators. The equipment is to be modern in every respect and every appliance is to be included in the equipment which will tend to the economical operation of the power plant. It is expected that the early spring will see this extensive system operated electrically.

Ogden's Car Fender.

An inexpensive, yet efficient fender for electric or cable cars is illustrated in the accompanying cut. It is substantially constructed and is quickly attached or removed from the car. As will be noticed, the fender consists of two frames hinged together and supporting a wire netting. The frame is attached to the car body by a flexible connection and further supported by chains hung from the top of dash board. The frames have cross bars which prevent the outer frame from swinging too low or sagging.

As is already indicated in the illustration a roller is suspended by means of two arms beneath the frame and just above the road bed. When an extra pressure is placed on the fender the roller is pressed down upon the road bed. The fender can thus come in contact with the roadbed without injury and is safely carried near the ground on uneven streets.



OGDEN'S CAR FENDER.

The forward frame projects in front of this roller and is intended to trip a person and throw them upon the netting of the rear frame. The weight being thrown upon the fender causes the roller to come in contact with the ground and to help support it. Guards at the ends of the fender prevent any one being thrown beneath the wheels at the side. The fender is very simple in construction, all parts being easily constructed at the shops of any railway. It is not complicated in any respect and cannot get out of order unless through an accident it is broken. When the car is run into the barn the fender is folded up out of the way. No room is taken up in the car barn by it. This fender is the invention of Mr. Herman B. Ogden, 204 Carroll street Brooklyn, N. Y.

Marie Besta Tavary appears this week at the Chicago Opera House, under the direction and management of Mr. Charles H. Pratt, who has managed many of the most successful tours made by celebrated actresses. The Tavary Grand English Opera Company contains a list of singers that have each made a reputation. Mr. A. L. Guille is one of the finest tenors on the stage and Mr. William Mortons is a baritone that one should not miss hearing. Wm. H. Hamilton is the basso and Mr. William Schuster is the basso contanta. The prima donna sopranos include Emma Mariani, Henrietta Droyer and Sophie Romani; the mezzo soprano, Mme. Thea Dorre and the contraltos, Helen Von Doenhoff and Dora Scott. These are but a few of the names of the members of the company. The repertoire for the first week includes "Il Trovatore," "Bohemian Girl," "Carmen," and "Faust."

New Monocyclic Alternating System for Simultaneous Light and Power Work.

The transmission of power by electricity may, without fear of contradiction, be said to be the most important development in the great science to which we are devoted. The success of almost all industrial operations being dependent to a large extent upon the possibility of procuring and utilizing motive power, the less costly its production and the more facile its utilization the more favorable become industrial conditions in general, and the greater the consequent benefit both to the producer and consumer.

The ideal system of power transmission must of necessity fulfill a somewhat complicated set of conditions. It must be possible to overcome distances ranging from a few hundred feet to many miles without serious loss of efficiency and to utilize the power obtained at either of these distances for motors and arc and incandescent lamps. Any system which cannot comply with these requirements is necessarily limited in its application, although, to accomplish these widely diverse purposes, it does not follow that the same system will be used.

So far as surmounting the difficulty presented by distance goes, the most important consideration is the voltage. For reasons well known it is imperative that, on long lines, high voltages be used, and in every case as high a voltage should be used as the engineering conditions render practicable. To reduce this voltage current to the proper pressure for distribution purposes, it is necessary in the majority of cases, to employ some voltage reducing device, such as a motor generator for direct current, and transformer for alternating current.

In order to unite efficiency and economy in all problems of electrical power transmission, the General Electric Company has initiated in this country three methods, each of which has its important use. The direct current for short distances where high voltage is unnecessary, the high frequency alternating current, where self-starting motors and great distances are not an important factor in the problem, and finally, the low frequency alternating system, either three phrase or monocyclic. For distribution of alternating currents for power, with incidental lighting, and for all long-distance transmission, where the cost of the line is a considerable item of expense, the three-phase system has been devised and has answered all the great expectations based on it. While for distribution of alternating currents for lighting with incidental power, the low frequency, single phase alternating system has been invented. To it has been given the name, monocyclic, and it constitutes a complete central station lighting and power system. It takes the place of the well-known high frequency system in central station work, operating transformer systems and distributing net works in the same manner, with the additional advantage of being able to supply the current to motors by means of a balance wire, which is carried only to places where the motors are to be used. The principle advantages attained by the monocyclic system are the following: It can operate incandescent and arc lamps and motors in parallel from the same generator and from the same transformer; it solves the problem of the operation of alternating current motors which has for so long proved *bete noire* of the electricians—the motors employed being not only equal but superior to continuous current motors in their constancy of speed, great simplicity and absolute reliability, commutators, collector rings, brushes or moving wires being entirely absent. They can be started at full load with normal current. By the flexibility of voltage incident to the use of the transformer it is able to operate low tension net works on the Edison three-wire system in the same way as the continuous current lighting system, and even with the use of the same overhead or underground mains. It affords a better balance and entails less expenditure of copper by replacing the heavy low tension feeders with high tension primaries of much less cross section feeding into the mains by transformers.

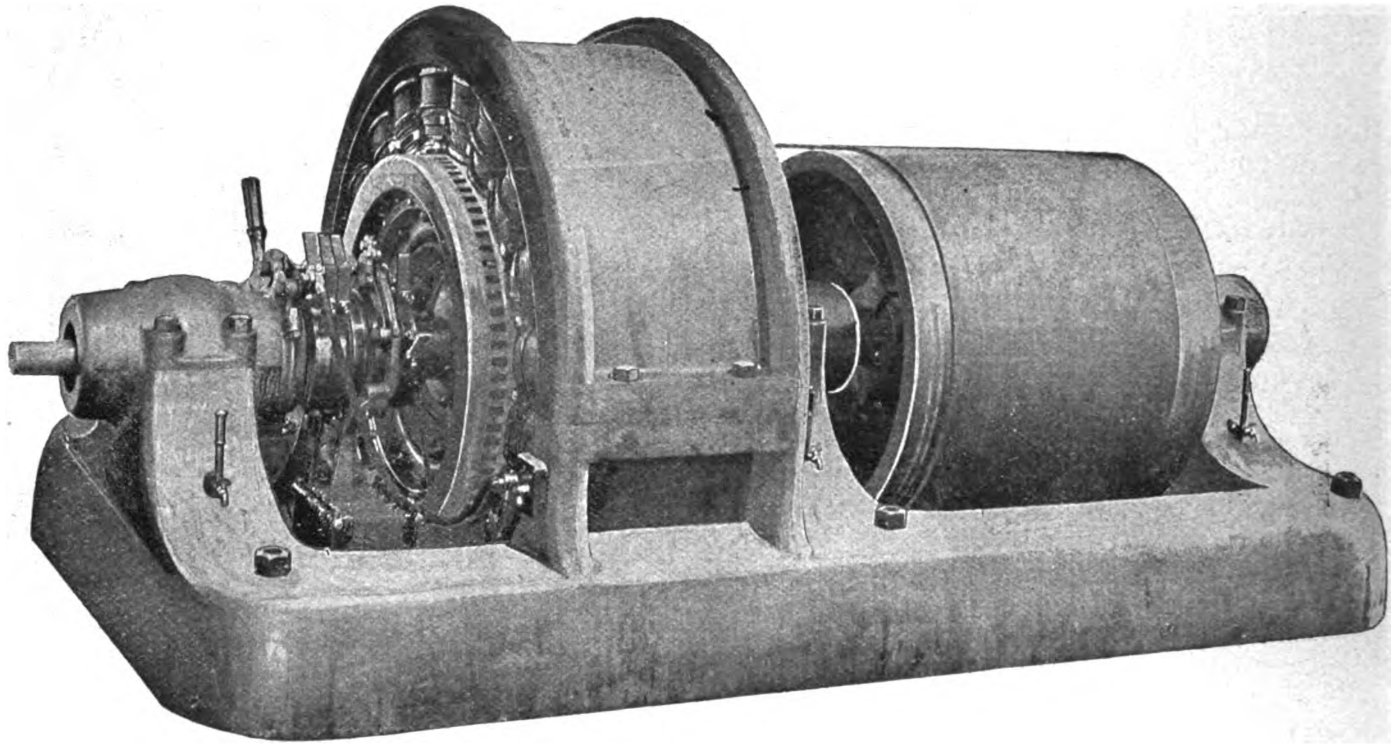


FIG. 1.— NEW MONOCLYCLIC ALTERNATING SYSTEM FOR SIMULTANEOUS LIGHT AND POWER WORK.

It offers the same simplicity as the ordinary alternating current system, and differs from it only in its ability to operate high grade motors by means of the third wire, which is similar to the neutral wire of the Edison three-wire system. It allows perfect operation of the whole system of the generators in parallel, the whole lighting and power station being operated from three bus bars, only the third bus bar being provided for the supply of current to the motors. By the use of two transformers, three-phase, quarter-phase, or any other type of alternating motor may be supplied with current. The low frequency of 7,200 alternations per minute used with this system reduces the effects of line inductance and is consequently favorable to transmission over long distances. The generators and motors are both slow speed, and for both generators and transformers are claimed an efficiency and regulation never before attained.

As before said, the lighting system is operated in the same way as in the old alternators by two wires and one transformer, which supplies a two-wire or Edison three-wire system from its secondary terminals. From the same mains, however, motors are operated, and in this case two transformers are used, connected between the main wires and the supplementary or power wire; in which, by the action of the motors, an intermediate but laterally displaced voltage is established and maintained. For this purpose the generator armature contains, besides the main coil, a small supplementary or teaser coil, which is connected with one end to the center of the main coil, while the other end is led to the third collector ring. It is obvious that this third collector ring is used only for supplying motors, while the lightning current passes exclusively through the main collector rings, and that the third or power wire needs to be carried only to where motors are located, and, since since it does not convey large currents, needs to have a small cross section only.

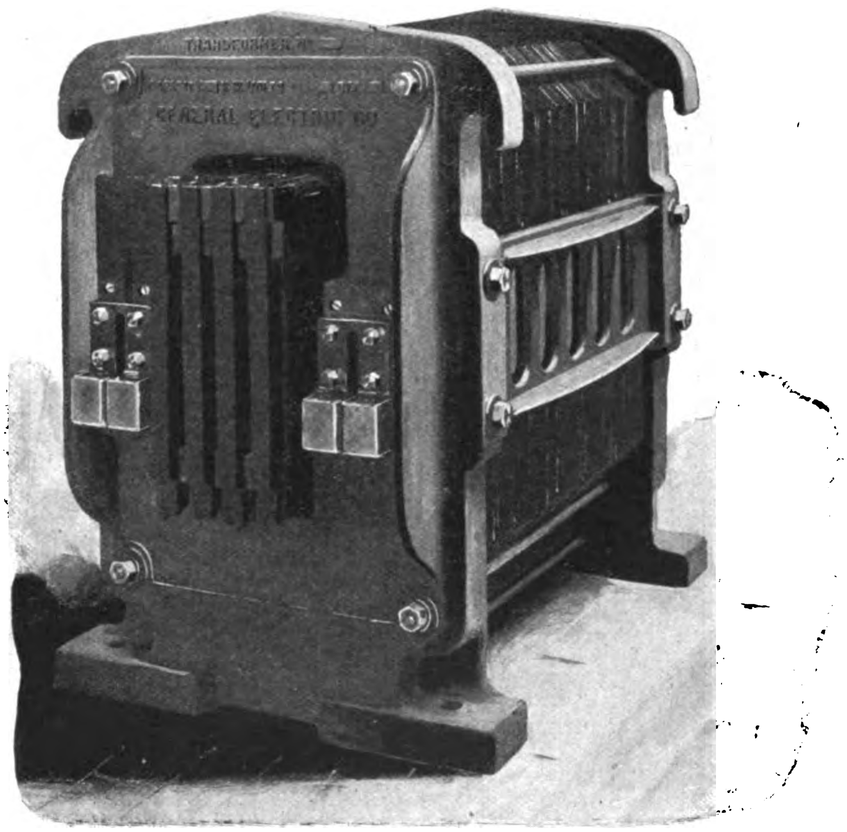


FIG. 2.—NEW MONOCLYCLIC SYSTEM FOR SIMULTANEOUS LIGHT AND POWER WORK.

The alternating current generators have been designed with all the qualities requisite constantly in view. The reliability of the machine is increased by the cars bestowed on the insulation which renders the use of high voltages possible. The number of armature coils has been reduced, and these coils are machine wound, insulated and afterwards slipped into the armature slots, thus they are easily replaceable. The generators are compounded for constant voltage under all loads, or over compounded up to 15 per cent to take care of the drop of voltage in the line.

The transformers employed in the monocyclic system are designed for frequencies between 33 and 60 cycles, and have as high an efficiency as the standard transformers. Thus they can be operated not only at the standard frequency of 60 cycles, but also in those cases where for long distance work 33 cycles have been chosen. All these transformers are oil insulated.

Substation transformers have also been designed for power transmission work where the transformer units may be banked in groups of large output. These are more particularly suited for step-up and step-down work, and for all sub-station distribution. They are without oil insulation, the coils being so insulated as to render this precaution unnecessary. They are thoroughly ventilated, and each bank is provided with one or more ventilating blowers passing a draft of cool air through them. The efficiency of these transformers is very high, notwithstanding the decreased frequency owing to the care used in the selection of the iron, and ranges from 96.5 to 98 per cent, and even higher in very large units.

The most interesting feature of this monocyclic system is the monocyclic induction motor operated therefrom. As our readers are aware, an induction motor is one with a closed circuited armature having no connection with the supply circuit. Such a motor, however, cannot with a simple alternating current of the old type of machinery, start of itself from rest under full load without excessive current. This difficulty has been overcome in the new monocyclic motor. It has a closed circuited armature wound with a small number of heavy copper bars of low resistance, and a starting rheostat is placed within the armature spider. At starting the coil sliding along, the shaft is kept out of contact with the switch used to short circuit the resistance, but when the motor is approaching full speed, the contact ring is moved along the armature shaft, until the armature is short circuited on itself. Thus, a very large starting effort is obtained with the current limited to a reasonable amount by resistance.

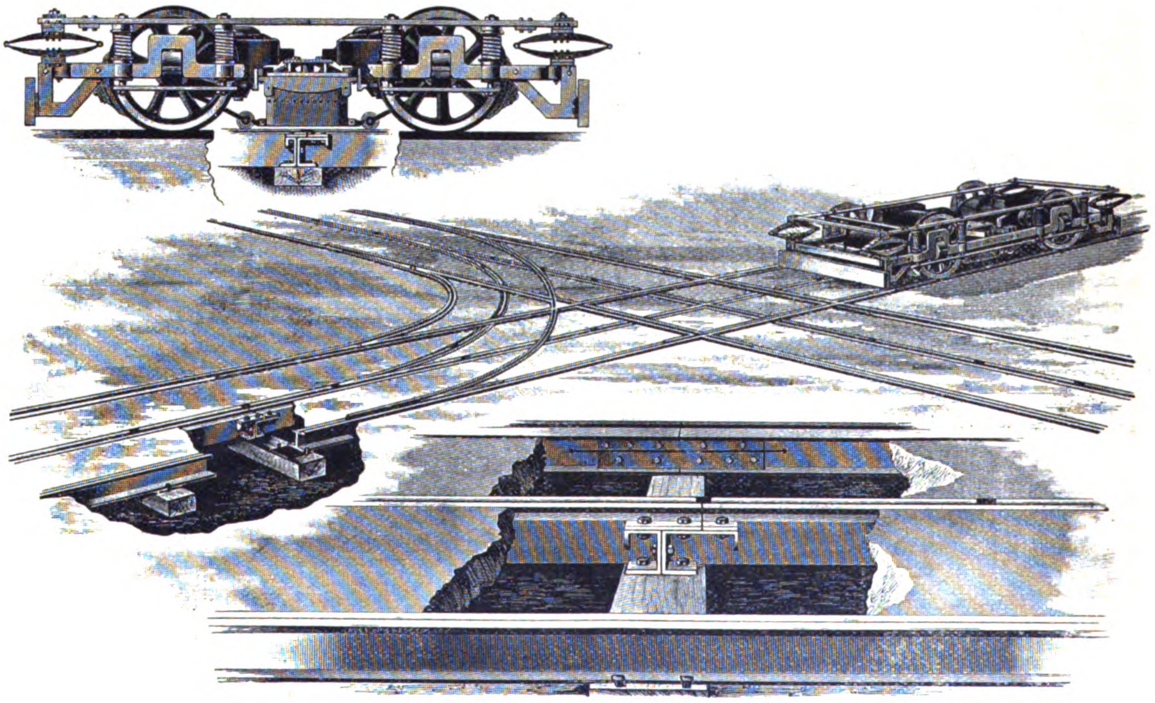
In all the standard induction motors, the starting resistance is adjusted so as to give a starting torque 50 per cent in excess to the running torque at full load, and requiring therefore an excess of 50 per cent of current over full load current. By special adjustment of the starting resistances, the starting current proportionally, while a very large starting effort of 10 or more times the running torque, can be secured by a corresponding expenditure of current. The field winding of the motor is very similar to that of the three phase induction motor, with the difference, however, that only two of the three terminals are connected with each other, and with the teaser coil of the generator by the intervention of transformers.

The result of this arrangement is that in this teaser or power wire, an exchange of current takes place between the different motors and the generator, in a similar manner as in the neutral wire of the Edison three wire system. Thus the power wire does not carry large currents, but only the magnetizing currents of the motors acting as an equalizing connection between them, and needs to have a small cross section only.

New Underground Electric Railway System.

This system is one invented by Mr. James F. McLaughlin. of Philadelphia, and differs in several respects from those heretofore developed. The system is not difficult to install, and trolley roads are easily changed to it. The method of distribution consists of a main tube of cast iron, made in sections, and which are laid on the ties midway between the rails. A controller is bolted beneath the car, carrying two collectors, which are always in contact with the surface conductor.

The current is carried by a rod within, but insulated from the cast-iron tube. The electrical connection is made, it is said, without the use of magnets, switches, or automatic devices. The method, however, is a secret, which the owners are holding until additional patents are granted. There is no danger, it is claimed, of the current escaping and doing damage, and the system can be put in as cheaply as the present trolly system. To equip the roadbed a space eighteen inches in width is dug in the center of the tracks, the conduit fastened down on top of the sleepers, the street repaved or cemented over the conduit and the system is ready for use. The roadbed is smooth without ridge or opening. The only thing to indicate the presence of the conductor is the flat level strip, an inch wide, on top of the conduit. No change in the present equipment of the power station is necessary.



NEW UNDERGROUND ELECTRIC RAILWAY SYSTEM.

This system, which was exhibited at the Hotel Kimball, at Atlanta, during the convention, attracted a good deal of attention. A large model was shown which illustrated the construction of the roadbed and the operation of the car. If the claims of the inventor are fulfilled, the owners will have no trouble in finding purchasers for the system, as it seems to meet the requirements of the desired system for business streets and thickly populated districts. The owners expect that they will be ready shortly to equip roads with this system. The manager of the affairs connected with this system is Mr. George Lodge, of 1200 South Third street, Philadelphia.

National Switchboard Instruments.

The advantages of being able to supply the entire electric equipment of central stations, and the demand for standard grade of instruments, at moderate cost, has led the National Electric Company to establish a special department for the manufacture of switchboard instruments. Instruments are manufactured to accompany either the direct or alternating current equipments.

NATIONAL SWITCHBOARD INSTRUMENTS.

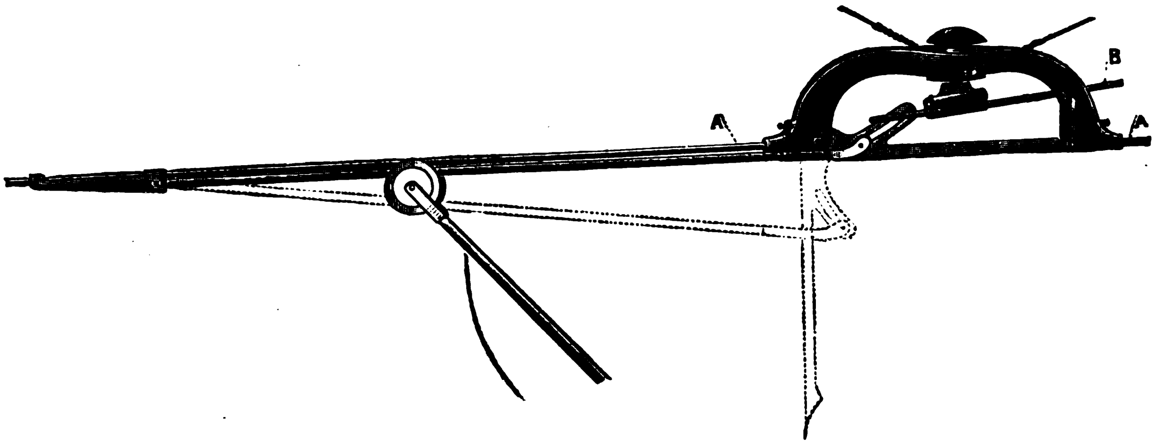
The movement consists essentially of a solenoid with a small excentrally fixed armature which acts magnetically upon a minute movable armature attached to the pointer. The staff which carries the pointer is mounted in frictionless jewelled bearings; and the whole movement is extremely light and is balanced with the greatest nicety. The simplicity of the movement is a strong safeguard against its getting out of order.

Equal increments of voltage or current produce nearly equal additional deflections. The scale is, therefore, even throughout its entire range. The energy absorbed by the in instruments is inappreciable. They are designed to remain constantly in circuit, which is a feature greatly appreciated, as the indicator is always in view of the attendant. The movement is exposed to view and all parts are given a highly ornamental finish. The instrument case is of a neat design and is most carefully made and put together. The cases are finished in several designs which harmonize with the different colored bases or switchboards. The excellent taste displayed in these instruments makes the switchboards when completed an attractive ornament in any station.

Fletcher's Rapid Transit Switch.

The increase in number of electric railways and the frequent crossing of tracks and trolley lines necessary has created a demand for new crossing appliance. This demand is being rapidly filled by the manufacturers, who are quick in originating such devices as the needs seem to require. In the accompanying cut is shown Fletcher's rapid transit switch for trolley wires. It is intended especially for use on lines that it is required to keep insulated from each other. By the use of this switch each line is made continuous and a free passage is given to the trolley wheel of both cars.

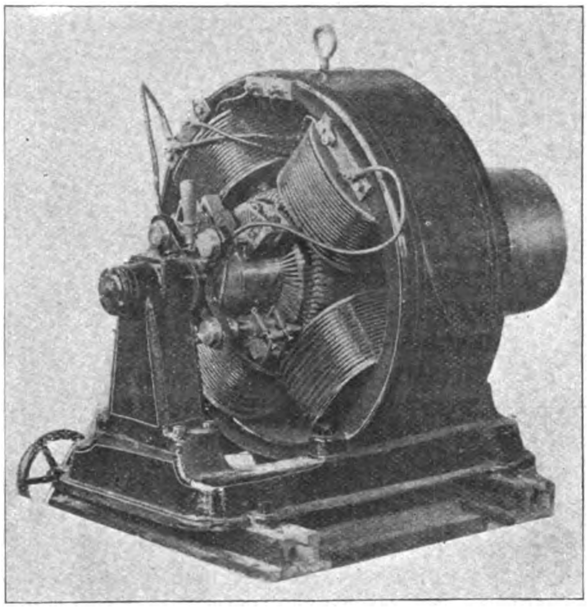
There is no break or jar of the trolley as it makes the crossing, nor anything to throw it from the wire. The construction of the switch is clearly shown in the cut. The letters A A represent the trolley wire, which is joined by a strong arch, as shown, and which forms part of the circuit. This arch is supported by an insulated hanger, which also supports the trolley wire of the line crossing that of the above. This wire, as will be noticed, is held above the other, so that there is sufficient room for the switch beneath it. A steel rod is attached to the trolley wire A A by means of a steel shoe. The peculiar shape of the latch is shown by which the upward pressure on the rod by the trolley closes the switch, making a smooth and continuous wire for the passage of the trolley wheel. As soon as a car has passed, the latch drops and the other trolley line is open for the car on the other track. The length of the rod and the slight distance it is raised in throwing the latch in position does not cause any sudden jar or violent movement which would tend to destroy the switch. There is no arcing at the switch, as the size of the bridge is sufficient to prevent a difference of potential on the two sides of the switch. The action of the switch is so smooth that it is not necessary to slacken speed to cross safely. The crossings largely used frequently throw the trolley off, and therefore require the conductor to be at the trolley rope. The advantages of this switch in this respect are at once apparent.



FLETCHER'S RAPID TRANSIT SWITCH.

Zahn's Multipolar Dynamo.

The dynamo shown in the accompanying cut has been designed by Dr. G. H. Zahn, of Corry, Pa. As will be noticed, it is of the multipolar type, well proportioned and substantial in appearance. In its design care has been taken to produce neat outlines, solid construction and mechanical strength, while in the electrical design the efficiency, close regulation and perfect insulation are well cared for.



ZAHN'S MULTIPOLAR DYNAMO.

The frame, which also forms the yolk of the field magnet, is ring shaped and cast in one piece. A good magnetic circuit is thus assured. The field cores are located at equal distances on its inner surface. The frame rests firmly on the base plate, upon which also rests the blocks supporting the bearings. A large and well-secured wrought iron eye bolt affords a convenient place to attach the tackle when setting up the machine. The armature is of the Gramme ring type, the core of which is built up of rings of special annealed iron. The separate sheets of iron are insulated and then clamped firmly together by means of the two halves of a bronze spider held together by steel bolts in the interior of the core. The armature is doubly insulated and every precaution is taken in placing the windings to prevent short circuits. The commutator is built up of tempered copper segments separated by insulating sheets of mica. The armature is mounted on a straight steel shaft of good size.

The bearings in which this shaft is carried are large, self-oiling and self-aligning and made of phosphor bronze. The brush holders are of a recently devised type and hold the brushes with sufficient tension to make a good contact but not hard enough to cause wear of commutator or destruction of brushes. The brushes are easily shifted by the handle that turns the rack. This line of machines comprises sizes ranging from 100 to 2,000 light capacity. They are manufactured by the Electric Manfacturing Company, of Corry, Pa. The maker guarantees a high efficiency, freedom from defects both in workmanship and material, and an operation automatically regulated without sparking or undue heating.

Flexible Friction Clutch Pulleys.

The friction clutch pulleys here illustrated are manufactured by the E. W. Bliss Co., of Brooklyn, N. Y. The manufacturers were convinced after using large numbers of clutch pulleys on the machines for the manufacture of which this company is well known, that this clutch was far superior to those on the market. The company, after a thorough investigation, procured the patent rights and erected the necessary plant for their manufacture. The mechanical construction of the clutch is shown very clearly in the detail cut. One of the important features is the flexible friction disc against which the clutch members grip. If the pulley wears out of true on the shaft the grip of the clutch will be as firm as ever.

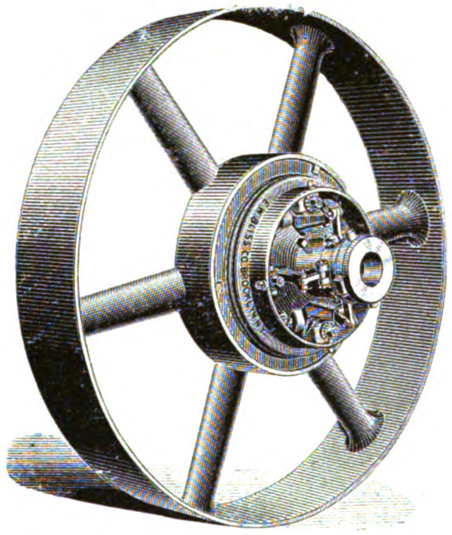


FIG. 1.—FLEXIBLE FRICTION CLUTCH PULLEYS.

It needs no adjustment to compensate for wear. There are few parts, none of which can get out of order. Of the two clutch members one is keyed rigidly to the shaft and the other is movable. The clutch is very compact and occupies little space on the shaft. The clutching members are circular, the only projecting parts being the levers, so that its appearance on the shaft is neat and symmetrical. The levers are so accurately balanced that no matter at what speed it may be run it cannot throw the clutch in or out of operation.

Another important feature is the system of bushings for pulleys so arranged that if on account of long continued use, or where a poor quality of lubricant is used, the bore becomes worn, the bush can be returned to the maker and exchanged at small cost for one with a new lining. All parts are made to standard sizes and are consequently interchangeable. The horse power which the various sizes of clutches will transmit is obtained from actual tests by means of a dynamometer especially constructed for the purpose. The makers guarantee that the clutch will attach to any pulley and will transmit more power than can be transmitted by a double belt the full width of the pulley.

The list of sizes in which these flexible friction clutch pulleys are manufactured is most extensive, and includes pulleys for almost every service. In addition to this list the company make special pulleys in accordance with specifications furnished. The company has an established reputation as manufacturers of machinery and in this new line purchasers may look for work of the highest order.

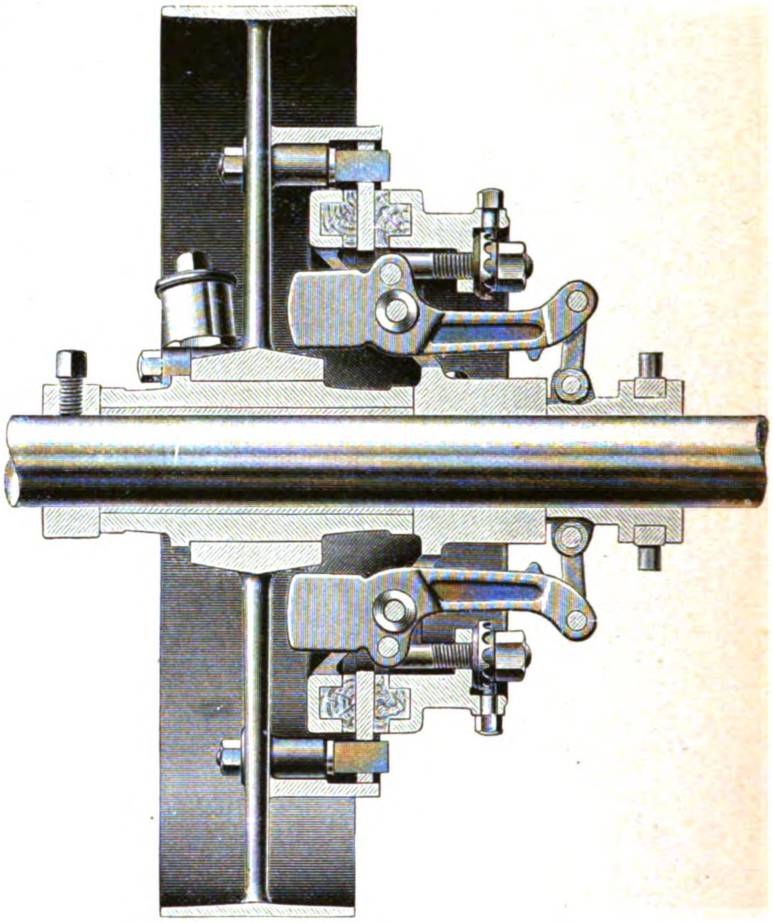
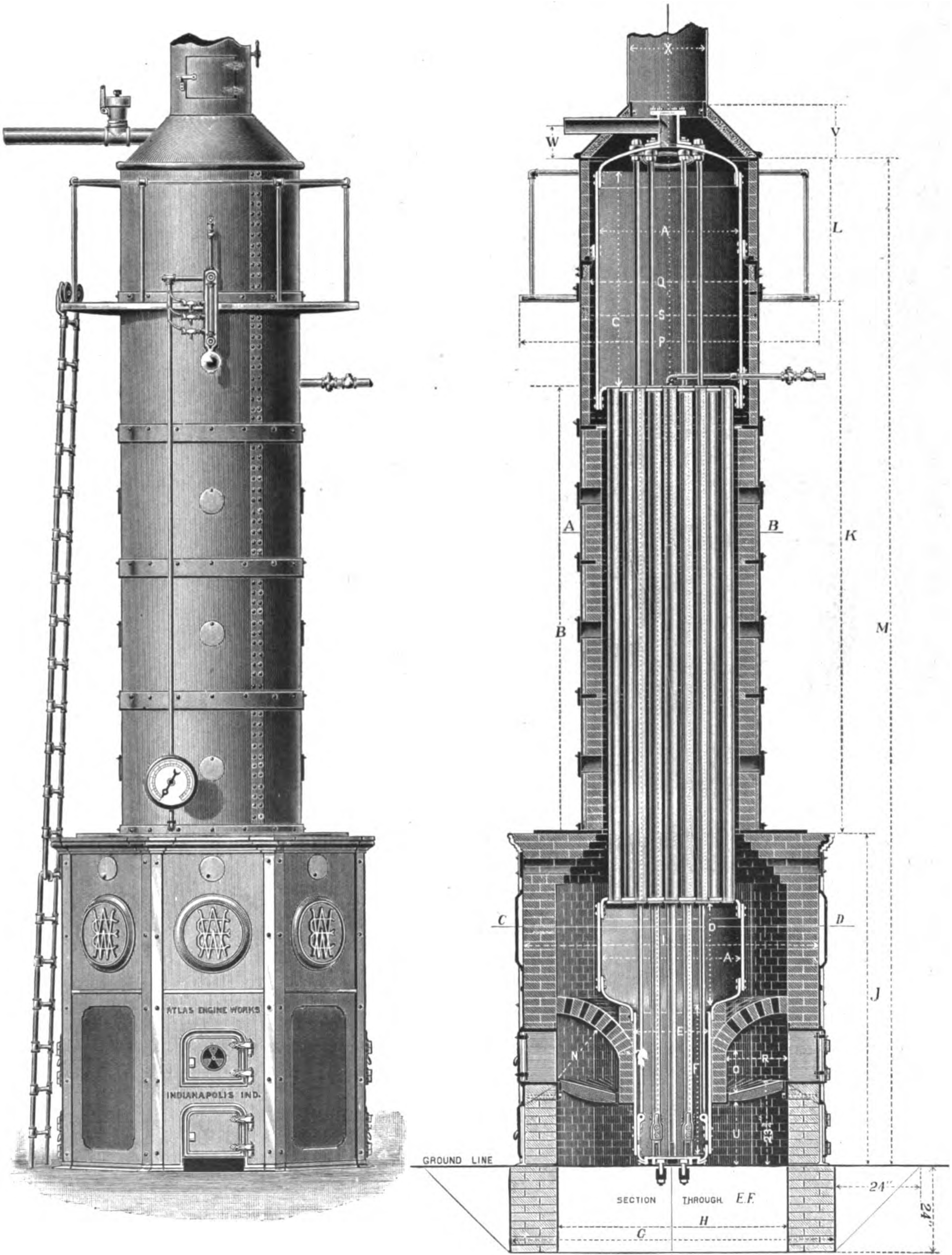


FIG. 2.—FLEXIBLE FRICTION CLUTCH PULLEYS.

A New Water Tube Boiler.

In the accompanying cuts is shown a new vertical high pressure water tube safety boiler designed and manufactured by the Atlas Engine Works, Indianapolis, Indiana. One cut shows the external appearance of the boiler and the other a cross section illustrating its construction and distribution of the various parts. As will be noticed it differs widely from the usual practice, but the advantages in point of economy and efficiency will be at once apparent to steam users. To central station and power men, whose plants are necessarily located where space is valuable, the small floor space required is worthy of mention.

The boiler is mounted in an upright position within an enclosing casing lined with fire brick. The lower part is a peculiarly shaped drum of an inverted bottle form, a central portion of less diameter extending down below the grate, while the main portion is held at a considerable height above the fire. The contracted portion of the lower drum is encased by fire brick. The mid-height of the boiler is a set of vertical tubes. The upper part is a drum in which a liberal surface is presented for the disengagement of the steam from the water. The descent of the water through the central tubes is promoted by a set of telescoping tubes extending the water tubes to near the bottom of the water leg, which may be slipped up into the water tubes out of the way whenever necessary to enter the water leg for cleaning or repairs. When extended downward so as to be fully efficient, these tubes protect the central set of tubes from being affected by the large volume of steam generated in the exterior portion of the lower drum.

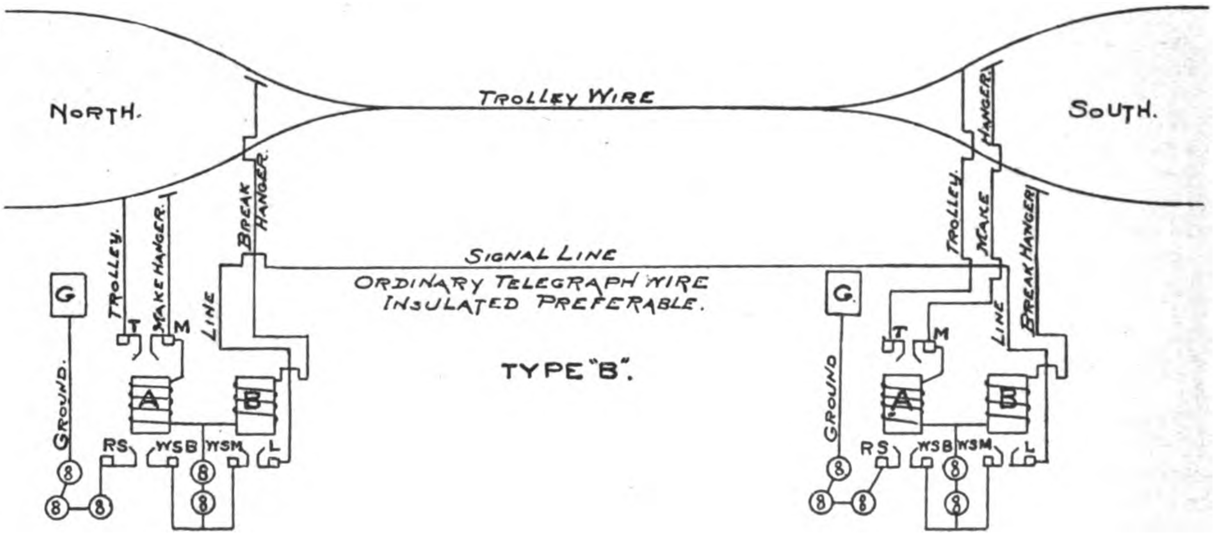


FIGS. 1 AND 2.—A NEW WATER TUBE BOILER.

The steam generated there rises through the series of tubes above, and insures an active upward current of steam and water through these tubes, and further steam is generated in these tubes by the circulation of the gaseous products of combustion through the spaces between them, the steam and water thus arising separate in the upper drum and the steam is conveyed away for use. The water descends through the central tubes of the series, which tubes are over the central portion of the bottom. The small quantity of steam generated in these central tubes is carried down by the descending current and moving outward in the lower portion, rises and contributes to the vigor of the strong rising columns in the tubes near the periphery of the series. The non-conducting protection between the central portion of the boiler and the annular furnace which surrounds it protects the fire from being too much cooled along the inner edge and allows all portions of the grate surface to be about equally efficient. The fire-brick also preserves that portion of the boiler from being overheated in any exigency. The annular grate is slightly inclined inward. The annular furnace is fed, cleaned, etc., through doors in the outer casing. A perforated protection of fire brick is extended over the fire at a proper height. At the mid-height of the tubes the masonry wall is extended inward so that it comes nearly or quite in contact with the outermost tubes. The hot, gaseous products of combustion deflected inward thereby are caused to circulate among the tubes. They are afterwards let outward and upward around the exterior of the upper drum and finally collected and conveyed away through a central stack at the top.

The Wightman Block Signals.

Managers of single track roads have long felt the need of simple and reliable signaling devices for these roads. Frequent accidents in foggy weather and many delays have made it almost imperative that some system should be adopted. The system here illustrated has been developed and is manufactured by H. J. Wightman & Co., of 414 Spruce St., Scranton, Pa. It is strongly constructed and reliable in action.



THE WIGHTMAN BLOCK SIGNALS.

The signals consist of a box containing the signal mechanism and two contact hangers located at each end of the stretch of track. The signal mechanism consists of two solenoids, one connected to the "make" hanger for establishing and one connected to the "break" hanger for extinguishing the signal. Within each signal box are five incandescent lamps. When the signal is in operation two of these lamps are connected in series with the three lamps in the distant box. The lighting of the two lamps on one side of the box is a signal to the motorman that the track is clear and he has the right of way. The appearance of three lamps in the opposite half of the box indicates that a car is approaching from the opposite direction and the track is blocked.

The only movable parts of the entire mechanism are the plungers of the solenoids. The passage of the trolley wheel by the hangers energizes either one or the other of these magnets, drawing up the plunger, thus establishing the signal connection or breaking it as the case may be. The method of operating the system is illustrated in the accompanying drawing. Suppose a car to leave north switch for the south switch; the trolley wheel will operate the "make" hanger, which sends current through solenoid of A of the north signal box, thence through the two white lights the W S M. contact, through signal line to W. S. B. contact to the three red lamps to the ground. A motorman reaching the south switch will notice the signal showing block is closed and remain until it shows that it is clear. On the arrival of the car from the north switch the trolley wheel will pass the "brake" hanger at the south switch, which will send the current through solenoid B of south signal box through the white lamps, the W S B the three red lamps to ground, whereby the contact bolt of solenoid thus lifted clear of W S M and L contacts, thereby interrupting current in signal line and operation of red lamps in south box. When car runs in opposite direction the operation is similar except that the boxes are reversed.

In the extension of the electric lines on the Chicago City Railway several lines have been opened during the past month. In changing from horse to electric the crossings and curves have been changed, but the rails previously in use are being used. The paving is taken up at the joints, the rails bonded and the paving put back in place again. Iron side-poles are being used.

The first electric lighting plant of importance in England operated by water-power was recently opened at Worcester. The plant also contains an auxiliary steam plant for use in times of drouth, when the supply of water is not sufficient to operate the dynamos. This station has been erected at a cost of some $200,000. The water-power, which is of from 300 to 400 horse-power during the most of the year, is located some two miles from the town. The alternating current system is used. There are 4,000 incandescent lamps, 27 arc lamps and a number of motors operated by this station. The power-house is a substantial structure, two stories high, and built over the stream. The turbines are of the Victor type and are located in the lower story.

LEGAL NOTES.

INJUNCTION GRANTED.

In the case of the Accumulator Company vs. the Edison Electric Illuminating Company Impleaded with the Electric Storage Battery Company, tried in the United States Circuit Court for the Southern District of New York, Judge Lacombe on October the 8th handed down his decision granting a preliminary injunction as asked for by the Accommulator Company. The decision, which is not long, is here given in abstract:

"The battery company, which is named as a defendant, but which, being a non-resident, has not been served, and does not appear, manufacture the articles alleged to infringe. The illuminating company has contracted to purchase a large number of them, and is about to put them to use in this city. Complainant is the owner of Letters Patent, reissue No. 11,047, December 17, 1889, original No. 312,599, February 17, 1885, to J. W. Swan, for "secondary battery," a variety of electric storage battery. The original patent, No. 312,599, was considered by this court in Accumulator vs. Julien Company, 38 Fed. Rep., 117, and held invalid, as it described and claimed more than the inventor discovered. Thereupon the reissue was obtained, and said reissue was considered by this court and sustained in Accumulator vs. N. Y. & Harlem Railroad Co., 50 Fed. Rep., 81 (opinion by Judge Coxe). In an application, therefore, for preliminary injunction on the same patent the construction laid down in that opinion will be adhered to. The claim of the pateut is for: "A perforated or cellular plate for secondary batteries, having the perforations or cells extending through the plate and the active material or material to become active packed in the said perforations or cells only, substantially as described."

Jude Coxe held that although the art already showed plates in which the active material was packed into grooves or holes not extending through the plate, and also plates where the active material filled not only the perforations, but also the entire surface of the plate itself, Swan's combination, in which the perforations extended through the plate and the material filled the perforations only, was original with him; that it was not only new but useful, an important advance in the art, and that "the idea which has made these plates a commercial success was first given to the world in a practical embodiment by Mr. Swan." No new evidence tending to modify Judge Coxe's opinion being introduced, it settles the law of this case, and the only question here is whether defendant's plates infringe.

These plates, which are for secondary batteries, are perforated plates, the perforations extend through the plate, the active material is found in the said perforations, and in them only. Infringement by the completed structure is so plain that defendant has been constrained to insist that Swan's patent is practically for a process and, therefore, as defendant's process of making the plates is a different one, there is no infringement. Thus Swan constructed a plate with perforations or cells extending through it, and then packed the material in the perforations; defendants arrange pastilles or buttons of the material in a mold and then cast the plate around them. Manifestly the result is the same, whether the material is packed within the bounding walls of the perforations, or whether the bounding walls of the perforations are packed around the material. There is nothing in the patent or in Judge Coxe's opinion which supports the contention that the claim is other than what it appears to be—a claim for a completed article, not for a process of manufacture. Infringement is clear.

It is further contended on behalf of the defendant that complainant has been guilty of such laches a should preclude the granting of a preliminary injunction. In a case where this defendant, or its allied corporation, was complainant the Court of Appeals in this circuit held that the owner of a patent was under no obligation to sue every infringer forthwith upon discovery of the infringement, provided he proceeded with due diligence against the one whom he did sue (Edison Electric Light Co. et al. vs. Sawyer-Man Electric Co., 3 C. C. A., 605). There is no suggestion of any unreasonable delay in prosecuting the test suits against the Julien Company and the N. Y. & Harlem Railroad Co. Judge Coxe's decree in the last named suit is dated April 12, 1892. The present action was begun in August, 1894. During the intermediate period and for some years before, certainly since 1889, the Storage Battery Company made plates which differed from those sold to the illuminating company, both in the size of the plate and in the size of the buttons. Complainant insists that it did not prosecute for infringement by the earlier plates, for the reason that it did not believe them to be commercially harmful. The grounds for that belief are said to be the relative size of plate and button. In the latter plates the loss by accident, while in use, of the contents of a single hole, would not, it is asserted, practically destroy the usefulness of the plate, being only a loss of 1/256 of the active material. A similar accident to the older plate, however, would destroy its usefulness, as a single perforation holds 1-9 or 1-12 of the active material. This explanation seems a reasonable excuse for failing to prosecute against the older plates, and I find nothing in the transactions between the complainant's officers and those of the Storage Battery Company, which should estop complainant from maintaining this action. In April, 1893, certainly both sides understood and expressed their understanding in writing that the question of infringement of the several patents owned by complainant would be tested by suit.

As to the Danish patent, the conclusion reached by Judge Coxe without argument, viz., that "it is not for the same invention as the Swan re-issue," is concurred in by this court, after argument. Motion for preliminary injunction granted.

TELEGRAPH COMPANIES NOT COMMON CARRIERS.

The relations of the public to telegraph companies, arising out of an erroneous transmission of a message, has at last received a thorough consideration by the U. S. Supreme Court in Primrose v. Western Union Telegraph Co., 154 U. S., says the National Corporation Reporter. It has often been contended for, and often argued (if not decided) by the courts, that telegraph companies are common carriers and subject to all the rigid rules applicable to them. It was urged upon the court, that this point has never been squarely before the Supreme Court and should be so decided. Indeed in Delaware & Atlantic Telegraph Co. v. Postal Telegraph Co., 3 U. S. App. 30, it was stated that it is no longer an open question that telephone and telegraph companies are subject to the rules governing common carriers and others engaged in like public employment; that this has been so frequently decided that the point must be regarded as settled; and while it has not been directly before the Supreme Court, cases announcing such doctrine have been approvingly cited by that court in Budd v. New York, 143 U. S., which is confirmatory of Munn v. Illinois, 94 U. S. 113. To all this contention the Supreme Court now answers emphatically, that telegraph companies are not common carriers; that their duties are different, and they are not subject to the same liabilities, although they resemble railroad companies and other common carriers in the exercise of a public employment, and their duty to serve all alike without discrimination.

It is now held, that these companies may stipulate that they shall not be liable for transmission-mistakes beyond the sum received for sending it, unless the sender orders the message to be repeated, by being telegraphed back to the originating office for comparison and pays half that sum in addition. This result is reached by the court, Mr. Justic Gray traversing the field of adjudicated cases in all jurisdictions. Chief Justice Fuller, perhaps swayed by the reasoning of the Illinois cases on the subject, joined by Mr. Justic Harlan, dissented. The opinion states that Tyler v. Western Union Telegraph Co., 60 Illinois 421, and 74 Illinois 168 contains, perhaps, the fullest statement of reasons on the opposite side of the question, but the judge finds a "fallacy" in the reasoning of the opinion, and elaborates it.

The case settles a much mooted question so far as the national courts are concerned, and it is not difficult for telegraph companies to transfer their litigation to the national courts. Mr. Primrose procured a judgment for $1.15, the price of his message, but the costs of the suit must have been very large. Others will now profit by the established rule, which the great public will likely carefully follow.

A BRIEF REVIEW.

THE PROGRESS OF TELEGRAPHY.

The progress of telegraphy during the last quarter of a century is well shown by the statistical abstract published by the Board of Trade, and from which it appears that Germany was the first country in which a telegraph line was opened, in 1833. It is well known that in this country the first successful essay of a practical electric telegraph was made on July 25, 1837, by Cooke and Wheatstone, between Euston and Camden, on the London and North-Western Railway, and that the first telegraph line was set up in 1838 on the Great Western Railway, from Paddington to West Drayton. The United States followed in 1844, and then came in order of introduction Belgium, Austria, Italy, France, Holland, Switzerland, Sweden, Denmark, Norway, and Spain, in the last of which countries the first line was opened only on May 1, 1885. No data are given for Russia, and the statistics for that country come to an end with 1880, Russia being then fifth on the list of countries as regards the number of messages carried. The smallest number of messages despatched in 1870 (the first year selected) was 466,700, in Norway, and the largest number, 9,350,000, in Great Britian. Germany was third in the list, with 8,207,800 messages. The United States had a slightly smaller number of messages to its credit than Great Britain, the total being 9,157,646. In 1892, after the lapse of twenty-two years, Norway had still the smallest number of messages carried — viz., 1,649,544. Germany seems to have dropped from third place to fourth, with a total of 31,175,100. No figures are given for France in 1892, but in 1891 the number of messages carried was 32,397,000. The United Kingdom still retains the first place, its total in 1892 being 69,908,600, compared with 62,387,298 in the United States. Austria held fifth place in that year with 10,835,302, and Italy seventh with 8,322,925.—Mechanical World.

MECHANICAL vs. ELECTRICAL ACCUMULATORS IN RAILWAY WORK.

No engineer who has watched the fitful play of the ammeter indicators in railway power stations can have failed to be impressed with the effect on engine economy which the variations in load thus indicated must exert. It is not too much to say that the losses due to this cause are greater than those of all others combined, and hence it is of paramount importance to inquire into methods which may grant relief, especially for small roads. Falling back upon the experience gained in electric lighting in providing for heavy loads by means of an auxiliary storage battery, the electrical engineer naturally turns to this remedy, as his first choice. The first road equipped on this system, that running from Zurich to Hirslanden, Switzerland, has a normal generator capacity of 120 amperes at 550 volts and utilizes storage batteries which take care of fluctuations varying between zero and 200 amperes. It is evident that with such an installation the size and cost of steam plant, independent of the higher economy obtained, is considerably smaller than would be required where the current is derived entirely from engine driven generators. Another instance is that afforded by the Douglas & Laxey road in the Isle of Man, engineered by Dr. E. Hopkinson, where a midway storage station of 240 cells is usually connected in parallel with the two generating stations, one at each end of the line. The plant charges or discharges according to the requirements of the traffic, and is brought up to full charge at any time by means of a motor generator, placed in one corner of the storage battery house. Not only does this battery throw in its welcome reserve of current when an extra drain occurs, but it has a special function in winter. During that season, the road, which is chiefly dependent on tourists' traffic, is required by law to run two cars each way daily as a minimum. In order to carry out this requirement, the battery is charged up once a week and then takes care of the whole road, so thas the power houses are completely shut up the rest of the time. As the battery will discharge 70 amperes for 9 hours, and as the road is not seven miles long, it will be seen that the light and almost non-existent winter travel can be very comfortably taken care of by the auxiliary storage plant..

We are glad to note therefore that a similar storage battery plant is to be installed in connection with the electric railway at Merrill, Wis., as we believe that it will be the forerunner of numerous others. But in considering the problem of storing energy ready to be drawn on instantly, one must not lose sight of the old mechanical energy storer, the fly wheel. In his recent admirable paper on "Electric Railways," Dr. Edward Hopkinson remarks that if an efficient accumulator capable of working as a regulator, could be introduced, it would be possible to reduce the capacity of a generator plant by at least 35 to 40 per cent and at the same time considerably increase its efficiency. Such an accumulator, he ventured to suggest, could be found in better wheel construction. The idea here brought forward forms the subject of a paper read by Mr. John Galt, C. E., before the Canadian Electrical Association, in which the author devotes considerable attention to the construction of flywheels to withstand the work, and describing Prof. Sharps' bicycle wheel construction. There are thus offered two methods of overcoming the evil effects of load fluctuation in railway work. Assuming that the mechanical difficulties encountered in the construction of high speed heavy flywheels can be overcome, there are other considerations which would enter into the choice as between mechanical and electrical accumulators. Principal among these is the fact that no flywheel of practical size can take care of a prolonged overload, and when such a condition does arise, the flywheel becomes a most serious drawback. While it is true that the usual periods of fluctuation above the normal, in power stations, do not exceed a minute, and are usually less, there are times when this period is considerably increased, and then the flywheel, as stated, may actually become a drag, preventing the engine from recovering its speed. No such difficulty would present itself in the storage battery, which in a pinch might even take the entire load of the station for a short while. The electrical accumulator method certainly permits of a flexibility which cannot be obtained by the other method, and to that extent at least is therefore superior to it.—Electrical Engineer.

"WHAT ELECTRICITY IS."

"Do you suppose we will ever know what electricity is?" As I have been asked that question more frequently than any other since I became an electrician, I will try to clear the electrical atmosphere a little, and endeavor to bring this apparently mysterious agent down to the level of those forces with which we consider ourselves on more familiar terms, and in this attempt the reader is presumed to have only a common school knowledge of matters scientific.

Before considering, however, the immediate question what electricity is, it will be well to ascertain first what we really know about other natural forces, such as gravitation or heat, both of which we observe in daily operation with a sort of contempt that is born of familiarity.

What, then, is gravitation?

After a little reflection we are compelled to admit that it is quite beyond our powers to define clearly what gravitation is. We can only say at best that a terrestrial force affects all material bodies in accordance with certain fixed principles called the laws of gravitation, and on asking some professor of science the question, he replies: "Gravitation is a manifestation of energy, and its laws are so and so."

Let us try again. "What is heat?"

Heat, we say, is a mode of motion, but we at once concede that this definition is rather unsatisfactory, and does not give us a clear idea what heat is. We know, however, that heat affects different material substances differently. The same degree of heat, for instance, melts one substance and freezes another, and we make daily use of this knowledge.

Going again to the professor of science, he replies as before, that "Heat is a manifestation of energy, and the laws of its action are so and so." We note that his answer is the same to both questions, so he has made at least one significant idea plain, which is this: Both heat and gravitation are manifestations of energy, and so far at least are one and the same thing. The only important thing, after all, seems to be a knowledge of the laws that explain the action of these forces when at work, for this alone makes them subservient to our needs.

Every form of force, therefore, should be regarded as a different method or way in which the same thing, more properly spoken of as energy, makes itself known to the senses.

Of energy itself we can have no intrinsic knowledge, because it is intangible and invisible; and electricity is no more mysterious in this respect than heat or gravitation. It is fortunately placed within our power to learn by study and experimant the laws that control the action of any force, and it is, indeed, a great thing to say, even in this nineteenth century, that the laws defining the behavior of electricity, though of comparatively recent date, are as clearly formulated and as thoroughly understood as are those concerning heat or any known force.

The expression, "Energy in the form of heat, energy in the form of electricity," etc., is a trifle clumsy, but very conducive to clear reasoning, and leads us to the consideration of an important law of nature, which, thoroughly grasped, will bring the answer to our question, "What is electricity?" clearly into view.

This law is known as the principle of the conservation of energy, and teaches that energy or force, like matter, is indestructible. Thus, for illustration, a smith beats a nail with a hammer—raising the hammer against the gravity force, he brings it down with considerable power. He is not only doing work, but he seems to be expending or actually destroying energy, for to the superficial observer a certain amount seems to disappear at every bloy, but the principle we are now considering tells us this cannot be the case. It tells us that force cannot be got rid of; it only seems to disappear by changing form, always appearing somewhere else in a new guise or dress.

Nothing at first appears so mysterious as the attraction a magnet exerts upon a piece of iron or steel, but this is only because we are not accustomed to deal with this form of attraction, and on reflection we are forced to the conclusion that magnetic attraction is no more to be wondered at than the attraction of gravitation; both are phenomena of nature, and both are equally calculated to excite surprise at first view.

Whenever a force of attraction holds two bodies together, or tends to do so, we use some other force, generally in the form of heat, to separate them. Thus a heavy body rests upon the earth, held there by gravity; to lift it we use mechanical energy. In some way, however, this mechanical force always comes from heat, as when a steam engine is made to do the work; or if muscular power be used, as that of a man or a horse, the power is still traceable to the same source, for in this case also the force exerted orginates in the heat energy of the food, made available for use by combustion in the body, which is furnace, boiler and engine all in one machine, and which enables us to exert the muscular power derived from the heat energy of food in a useful way.

Return now to the magnet, which holds a piece of iron so firmly that it requires considerable force to tear it away, and suppose power be applied to remove it. What becomes of the mechanical energy thus exerted?

Continue for some time to rapidly apply the piece of iron to the magnet, and as quickly pull it away again. It will in time become warm, and eventually hot, as a result of this process, and so will the magnet also, though in a less degree.

Here, then, is force, that was originally exerted in the mechanical form, as push and pull to overcome the attraction of the magnet, appearing as heat in the piece of iron, and it looks very much as if we had simply converted mechanical energy into heat, as before explained.

Mechanical force applied to remove the iron from the magnet was first changed to the electric form of energy, existing as electric currents in the iron, but discoverable only with a compass or other suitable instrument, and not evident to the senses. The iron, however, opposing a resistance to the flow of the electric currents in its mass, altered the energy again to the heat form, when it became again evident to the senses, but in passing through these different stages it was always one and the same energy, different conditions and resistances having twice quickly altered its form or mode of manifestation.

It is important here to note how resistance of one kind or another is always the agent that acts to alter energy from one form to another. The attraction of the magnet (magnetism) opposed a resistance (mechanical) to the iron being pulled away, but this resistance was overcome, and the original forces were altered instantly by the resistance to the electric form, existing momentarily as electric currents in the iron. The iron opposed however, an inherent resistance to flow of electric currents through its mass, but they must flow because the iron was forcibly pulled away in the first first place—the fact which started all these changes going and which must come to a logical end. The resistance the iron opposed to electric flow was therefore overcome, but, as a direct result, the force at work (electricity) has again changed form, and now appears as heat, in which form it is radiated and dissipated into surrounding space.

It would, therefore, appear that electricity, as we have here observed it, is simply a form or manifestation that the one force better spoken of as energy may assume under given conditions, and generally, as in the case cited, it is a mere transitory stage between the mechanical form and the heat form.

In most operations mechanical force passes to the heat form without passing through the electric form; but, whenever magnetism is brought into play as a resistance that must be overcome, then mechanical power applied to overcome this resistance always becomes electricity, if only momentarily in its passage from the mechanical to the heat form.

Can we not now answer in a fairly satisfactory way the question, "What is electricity?" by saying that it is simply a form that energy may assume while undergoing transformation from the mechanical, or the chemical, form to the heat form, or the reverse?

There are, fortunately, many ways of obtaining energy in the electric form; but in nearly every case, if not quite all, it will exist as a transitory state of energy in its passage from some other form to the heat form. Thus, in the case of a battery, we start with energy in the chemical form, by which we mean the affinity or strong tendency that an acid has to unite with a metal to form a new combination, this chemical energy or affinity being a potential force of nature, like gravitation or magnetism.—Abstract of article in the New Science Review.

PORTATIVE ELECTRICITY.

The resources of electricity on a small scale have, according to an English contemporary, been admirably illustrated by an ingenious gentleman of Manchester. This individual carries an electric museum on his person. It combines utility with ornament, the idea originating in an effort to protect personal property from shiftless and elusive thieves. After being relieved of a valuable personal ornament, the gentleman who fell among thieves "rigged up," he says, "a small contact for my scarf pin, bought a tiny electric bell, made a double pocket accumulator, and am now ready for any emergency. I have also made a contact for my watch; thus, if any attempt is made to extract it quietly the tell-tale bell indicates the fact at once. The third item of my equipment is a tiny incandescent lamp concealed in a well-finished artificial water-proof flower pinned to my coat. Another piece of apparatus consists of a very fine platinum coil placed in a cavity made of asbetos. By inclining the little glass tube the mercury in the same closes the circuit of my pocket battery, and I can thus light my cigar, etc., regardless of the weather. The entire museum weighs about twenty-two ounces, and my only trouble is in recharging the battery. The latest addition to my store is a hollow cane fitted with a tiny lamp, provided with a small silvered reflector concealed in the knob. The cane is sealed at the bottom by a rubber stopper, and the exciting fluid is a mixture of chronic and hydrochloric acids. The cell consists of an amalgamated zinc rod and a strip of platinum foil. This type of battery was used for Tissandier's navigable balloon. By inclining the cane the lamp is fed by an electric current, and gives a good light." For ingenuity and completeness this poitative museum of electricity is not only a record breaker, but an apt illustration of what the electrician can do with invisible forces he can control and manipulate.—Age of Steel.

Storage Batteries For Electric Traction.

In an article on the above subject Mr. Pedro G. Salom presents the following facts:

Assuming, for the sake or argument, that electric storage traction is practicable, what are the problems that confront the engineer? The first and most important is the life of the battery. Then come the capacity, the rate of discharge, the weight and size of the elements, the loss of power in the various transmissions between the prime mover and the axle; the distance or total length of line, the grade and curves, and the speed.

In traction work there is only one reliable method of determining the life of the battery, and that is on the basis of car mileage. It is nonsense to talk about batteries lasting eight months or eighteen months, unless there is a record, at the same time, of the amount of work accomplished, measured in electrical horse-power-hours. The highest record yet obtained, of which the writer has any reliable knowledge, is that of a single set of 108 accumulators making over 6,000 miles. This record was made under the most trying and unfavorable circumstances. Assuming that the battery could make 100 miles per day, this would mean that the positive plates of the battery would have to be renewed every two months; if fifty miles per day, then the life would cover a period of four months; at twenty-five miles per day, eight months, and so on. It can thus be readily understood that the bare statement that a battery would last six or eight months does not convey a correct idea of the real life of the battery.

Let us see what it would cost to run 6,000 miles with a single set of accumulators, or, since two sets are always employed, one being charged while the other is in service, we will make a calculation on a basis of 12,000 miles.

216 Positive groups at $2.50	$540.00
Credit 2,592 pounds lead scrap at 3 cents	77.76
Balance	$462.24

$462.24÷12,000=3.85 cents per car mile.

Is positive groups were renewed at $1.25 per group, instead of $2.50 each, which it would be perfectly possible to do, leaving out the question of patents and royalties, then the cost per car mile would only be 1.6 cents.

What amount of work is represented by these 6,000 miles, so far as the accumulators are concerned? It was found by keeping the most careful records on the Fourth Ave. line at New York, that the amount of energy consumed per car mile was about one and one-half electrical horse-power-hours. That is to say, that after making a round trip of eleven and one-half miles, it required about seventeen electrical horse-power-hours to replace the energy drawn from the batteries. Six thousand miles would, therefore, require 9,000 electrical horse-power-hours, and since a battery of 108 cells has a capacity of fifty-four electrical horse-power-hours for each total discharge, if we divide 9,000 by 54 we get 166 total discharges that are required of the battery, before the positive plates break down. Any one who has had any extensive experience with storage batteries, knows that this is a very conservative estimate of the amount of work that a good battery will do.

It may be asked, have there been no improvements in late years with a view of diminishing the number and weight of batteries required to propel a car? We regret to have to answer no, and this brings us to the consideration of the limitations of storage batteries. We have said that it requires about one and one-half electrical horse-power-hours per car mile, and that 108 accumulators are used and necessary for a twelve-mile run, and they have a capacity of fifty-four electrical horse-power-hours, or three round trips.

CONVENTION NOTES AND EXHIBITS.

The exhibits of the convention were a very striking feature and in number and importance it is safe to say exceeded the expectations of the delegates in attendance. The main body of the exposition building was given up to the manufacturers and supply men and it was well filled with apparatus and supplies. Many of the larger exhibits, consisting of cars and electric motor equipments, were shown outside machinery hall and in operation on the various lines of railways throughout the city. The fact that the convention meetings were held under the same roof with the exhibits gave the delegates the best possible opportunity to examine the new and improved appliances offered by the manufacturers and they availed themselves of this opportunity, much interest being shown. The wisdom of having the exhibits close to the meeting place of the delegates was very evident.

Levi Dederick, Albany, N. Y., exhibited his Dual street car fender.

Pepper & Register, Philadelphia, had in attendance A. L. Register.

The Scarritt Car Seat Co., Chicago, was represented by H. O. Nourse.

Fulton Truck & Foundry Co., Cleveland, O., exhibited a truck and car wheels.

The General Agency Co., New York, was represented by B. M. Tate, its secretary.

The Davis Car Shade Co., Portland, Me., showed curtains for street railway cars.

The Technic Electrical Works, Philadelphia, exhibited samples of the "Teck" rail bond.

The Falk Manufacturing Co., Milwaukee, Wis., showed samples of its new trolley wheels.

The New Haven Register Co., New Haven, Conn., made a handsome showing of fare registers.

The New England Engineering Co., Waterbury, Conn., had an emergency wagon on exhibition.

The Leonhardt Pneumatic Safety Car Fender Co., Baltimore, Md., showed samples of its fender.

The Sterling Supply & Manufacturing Co., New York, showed fare registers and other specialties.

E. F. DeWitt & Co., Lansingburgh, N. Y., showed a sample of their " Common Sense Sand-box."

The National Lock Washer Co., Newark, N. J., showed samples of its lock washer for all kinds of work.

Wm. Wharton, Jr., & Co., Philadelphia, was represented by Powell Evans, the salesagent of the company.

The Heine Safety Boiler Co., St. Louis, had its interests well looked after by its president, Col. E. D. Meir.

The Post-Glover Electric Co., Cincinnati, had in attendance Geo. N. Devou to look after its interests.

The Wrought Iron Bridge Co., Canton O., exhibited a new flexible adjustable bracket for street railway construction.

W. R. Brixey, the manufacturer of Kerite wires and cables, was represented by F. G. Fuller, who had with him samples.

The Graton & Knight Manufacturing Co., Atlanta, issued a neat invitation to the delegates to inspect its stock of belting.

The Bushnell Manufacturing Co., Easton, Pa., exhibited samples of its car seat for electric cars. It also distributed printed matter.

The Georgia Equipment Co., Atlanta, Georgia, exhibited samples of most of the leading specialties for which it is the southern agent.

Jno. A. Roeblings Sons Co., Trenton, N. J. was represented by Mr. Geo. C. Bailey, the general manager of the western territory.

The Young Lock Nut Co., New York, showed samples of the Brownley injector. The representative of the company was R. D. Stewart.

The Electrical & Mechanical Engineering & Trading Co., New York, distributed considerable literature regarding the "Booster system" and other electric railway information.

The Safety Clutch Brake Co., Philadelphia, was represented by E. V. Faucett, vice-president and general manager.

The Chicago Rawhide Manufacturing Co., Chicago, made an exhibit of some of its well-known rawhide pinions and gears for motor cars.

The Partridge Carbon Co., Sandusky, O., was represented by Jas. Partridge, who had with him samples of his well-known motor brushes.

Pullman's Palace Car Co., Chicago, had its interests well taken care of by W. S. Louttit, assistant contracting agent of the company.

Fairbanks, Morse & Co., Chicago, among other specialties exhibited samples of car jacks, head lights, etc. J. M. Cobb represented the company.

The Niles Tool Works Co., Hamilton, O., made an excellent exhibit of some of its special machines for electric railway work, including lathes, etc.

The Paige Iron Works, Chicago, exhibited samples of its track work for electric railways. E. W. Paige, the president of the company, was present.

Chas. L. Cornell, Hamilton, O., had on exhibition a novel appliance in the way of an electric soldering iron, which attracted a good deal of attention.

The New York Electrical Works, New York, distributed samples of a neat catalogue descriptive of its line of overhead material for electric railways.

The Peckham Motor Truck & Wheel Co., New York, showed a number of its well-known motor trucks. E. Peckham, president of the company, was present.

H. J. Wightman & Co., Scranton, Pa., exhibited a sample of the Wightman block signal for electric railways. This device was new and attracted much attention.

The Standard Railway Supply Co., Chicago, was represented by its president and manager, Garson Myers. Mr. Myers exhibited samples of stoves for car heating.

The Creaghead Engineering Co., Cincinnati, O., showed samples of the Creaghead flexible pole bracket, which was one of the novelties of the convention and attracted much attention.

Jewell Belting Co., Hartford, Conn., was well represented by C. L. Toles, who had with him samples of dynamo belting, also samples of belt dressing, a specialty of the company.

The Fuel Economizer Co., Matteawan, N. Y., was represented by B. Pearson, its general agent, who distributed quantities of printed matter descriptive of Green's fuel economizer.

Morris Tasker & Co., Philadelphia, were well represented at the convention. The company distributed some tasty literature on the subject of poles for street railway construction.

The Bass Foundry & Machine Works, Fort Wayne, Ind., had a large and attractive exhibit of various kinds of car wheels. The interests of the company were looked after by P. F. Leach.

The Empire Electric Insulation Co., Schenectady, N. Y., exhibited through its Atlanta agent, the Georgia Equipment Co., insulating cloth and paper, besides other insulating specialties.

The Meaker Manufacturing Co., Chicago, exhibited a variety of its portable and stationary fare registers. The company also showed a new mechanical clip that attracted considerable attention.

Chas. Munson Belting Co., Chicago, was represented by H. E. Skinner, who had with him samples of belting. The company also distributed a neat memorandum book containing its advertisement.

The Cutter Electrical Manufacturing Co., Philadelphia, made an exhibit of switches and cut-outs that was quite attractive. Charles E. Bibber and Walter E. Harrington represented the company.

The Standard Underground Cable Co., Pittsburg, had in attendance its well-known Chicago manager, F. E. Degenhardt, who had with him samples of wires and cables for use in street railway work.

The Street Railway Review was well represented by H. H. Windsor and H. J. Kenfield, who distributed a large number of copies of their special convention issue.

The E. T. Burrowes Co., Portland, Me., had on exhibition a large variety of car shades and curtains for street railway service. Jno. W. Baker represented the company.

Jno. H. Graham & Co., New York, had their interests represented by C. A. Hoagland, who had with him samples of the H. & C. sleet cutting trolley wheel and other specialties made by the company.

Benedict & Burnham Manufacturing Co., New York, had on exhibition several handsome samples of its product, prominent among which were solid one-piece rail bond and feeder, trolley and magnet wires.

The Hartford Woven Wire Mattress Co., Hartford, Conn., was represented by its western agent, H. F. Evans, of St. Louis, who had with him samples of the new Roberts patent woven wire reversible car seat.

The Rochester Car Wheel Works, Rochester, N. Y., exhibited a number of car wheels with the Barr contracting chill. The company was represented by F. D. Russell, general manager, and Geo. C. Morse.

The Johns-Pratt Co., Hartford, Conn., had its interests well taken care of by E. B. Hatch, the secretary of the company, together with Mr. H. Luscomb. The exhibit made by this company consisted of samples, etc.

The Hale & Kilburn Manufacturing Co., Philadelphia, was represented by its southern agent, B. B. Pilson, of Richmond, Va. The company showed rattan, plush and wilton carpet seating and samples of construction.

The Gennett Air Brake Co., New York, had on exhibition and in operation air-brakes, so that street railway men had an opportunity of investigating their merits. E. J. Wessels, the general manager of the company, was present.

The Guarantors Insurance Co., of Phila, had a pavilion, from which its general agents, Haas & Watson, Atlanta, Ga., distributed a very neat leather card case. This company makes a specialty of electric street railway insurance.

The Eddy Elec. Mfg. Co., Windsor, Conn., had its interests well taken care of by M. E. Baird, the general agent of the company. Mr. Baird distributed some very neat catalogues descriptive of the company's well-known generators.

The Stirling Co., Chicago, had on exhibition a model section of the Stirling water tube boiler, showing in miniature the action of the boiler in generating steam. Thos. Deegan, the secretary and manager of the company, was present.

Stilwell-Bierce & Smith-Vaile Co., Dayton, O., was represented by its southern agent, J. W. Taylor, of Atlanta. An interesting exhibit was made of the pumps, friction clutch pulleys and gearings, which are a specialty of this company.

Chas. G. Smith, New York ("Smith of New York,") had his interests well looked after by T. C. Millan, who showed samples of head lights in a large variety, together with street car electroliers, a center cluster light being especially fine.

The Ohio Brass Co., Mansfield, O., showed a full line of its street railway specialities, including railway motor bearings, overhead material, and car appliances. C. K. King represented the company. Some very neat printed matter was distributed.

Adams & Westlake Co., Chicago, had on exhibition samples of its leading street car specialities, including the Bessemer sheet steel headlight and car shade. The interests of the company were looked after by L. E. Gray and Geo. A. Crisson.

Arthur S. Partridge, St. Louis, was present and distributed large quantities of lead pencils in a neat case bearing his advertisement. Mr. Partridge makes a specialty of street railway supplies of all kinds and this fact was thus well advertised at the convention.

Jackson & Sharp, Wilmington, Del., exhibited one long new style of open car, also a closed car. These cars were kept in operation constantly between the hotels and convention hall. The company was represented by president Jackson and salesagent Geo. Pratt.

The Johnson Co., Johnstown, Pa., exhibited sections of girder and T rails; also slot rails. The representatives of the company were Daniel Coolidge, vice-president. W. W. Kingston, Eugene Thomas, W. E. Boughton, E. O. Evans O. C. Evans, and A. S. Littlefield, of Chicago.

The Columbia Incandescent Lamp Co., St. Louis, was ably represented by its president, J. H. Rhotehamel. Mr. Rhotehamel could show a large number of his lamps in use at various places and besides took opportunity to impress street railway men with the fact that the Columbia was still in the lead.

Lewis & Fowler Manufacturing Co., Brooklyn, had its interests well taken care of by F. A. Morrell and G. W. Whipp. In the company's exhibit was shown a street car stove and a passenger register. In addition to this exhibit the company showed a snow sweeper on the outside of the exposition grounds.

The Chapman Valve Manufacturing Co., Indian Orchard, Mass., exhibited a complete line of its well-known valves. The interests of the company were well cared for by E. W. Buss of Chicago, the western manager of the company. Edw. D. Ross, the mechanical engineer of the company, was also present.

The Sperry Electric Co., Cleveland, O., exhibited one of its new electrical brakes in operation on a car running between the hotels and the convention hall. It attracted a great amount of attention. S. H. Rogers, the general manager of the company, was present, together with Elmer A. Sperry, the inventor.

Chas. A. Schieren & Co., New York, had its interests well taken care of by C. A. Schieren, jr. Mr. Schieren had some samples with him and distributed to all those who attended the convention a very handsome memorandum book, upon the cover of which was a picture of its tannery located at Bristol, Tenn.

The Maxwood Brake Shoe Co., LaCrosse, Wis., had on exhibition something entirely new in the line of a brake shoe for electric cars. This shoe is made of a chemically prepared wood, solidified by hydraulic pressure. Many advantages are claimed for the shoe from the fact that it is practically indestructible.

The Central Electric Heating Co., New York, showed three styles of car heaters. These heaters were supplied with current and therefore delegates had an opportunity of seeing them in operation. The company was well represented by its generel manager. E. B. Wyman, also Messrs. R. S. Jerome and Sydney Hoch.

The Wallace Electric Co., Chicago, was represented by Max A. Berg, its secretary, who had with him samples of the Robinson patent trolley wheel, Fletcher rapid transit switch and the Paulsen railway bond cap. Mr. Berg also distributed a very handsome catalogue of electric railway supplies of the company's manufacture.

The Stanwood Manufacturing Co., Chicago, was well represented in the person of F. H. Stanwood, its president. Mr. Stanwood, while he made no exhibit in the convention hall, had a most valuable and practical display of his well-known steel car step on many of the exhibition cars as well as cars in everyday use in Atlanta. These steps attracted universal attention.

The R. D. Nuttall Co., Allegheny, Pa., made a very complete showing in the line of gears for all standard types of motors together with a full line of overhead railway material. It also exhibited an improved Nuttall trolley base showing the position as in operation. F. A. Estep, the president and treasurer of the company, was present together with Garson Myers, the Chicago agent of the company.

The Michigan Electric Company, Detroit, was represented by Jos. E. Lockwood, its president. Mr. Lockwood had on exhibition a complete line of new overhead material. The feature of the exhibit that probably attracted the most attention was a clamp for overhead trolley line insulators. A new signal light was also shown, for designating the different car routes by means of various colored lights.

The International Register Co., Chicago, had a very attractive exhibit of stationary and portable street car registers and gave away very neat descriptive matter to all interested. The company was well represented by E. H. Englund, secretary and manager of the company.

The McGuire Manufacturing Co., Chicago, had its interests well taken care of by W. J. Cooke, vice-president, and J. A. Hanna. The company showed in operation one double truck car equipment with a McGuire adjustable traction truck, also a car with Columbian A1 suspension track. A neat penwiper was distributed as a souvenir.

The Weston Electrical Instrument Co., was represented at the convention by Richard O. Heinrich, who was on hand to discuss the merits of the Weston instruments in use by so many railway companies. The principal exhibit made by the company was in connection with the exhibit of the General Electric Co. Mr. Heinrich distributed literature bearing on the subject of electrical instruments.

The Street Railway Pub. Co. had a handsome pavilion. The souvenir edition gotten out by the company in commemoration of its tenth anniversary was an elegant piece of work. The publishers received many well-deserved compliments. J. H. McGraw, the president of the company, and C. B. Fairchild, editor, were present, together with W. H. Taylor, J. D. Bennett, Edw. Caldwell and H. W. Pool.

The Wadhams Oil & Grease Co., Milwaukee, Wis., was represented by G. A. Streeter, who had with him samples of Wadhams' graphite curve grease, graphite motor lubricant, Badger motor lubricant, Cream city motor lubricant, No. 20 valvine cylinder oil, Eureka cylinder oil, Royal dynamo oil, special dynamo oil, floor soap, Magnolia metal, etc. The exhibit attracted a good deal of attention among street railway men.

The Berlin Iron Bridge Co., East Berlin, Conn., was represented by J. M. Field. The exhibit made by this company was quite a novelty, as it consisted of a section of roof of a small power station. The construction of this roof was thus clearly shown. The exhibit attracted a good deal of attention. The company also distributed some handsome literature upon the construction of railway stations, which is one of its specialties.

The Western Telephone Construction Co., Chicago, had a switch board with switch board transmitter, head-phone, generator, and night alarm. The switch board was connected up with telephones throughout the hall, so that a person could get an idea of the complete working of the system. Magneto telephones, portable desk telephones, etc., were also shown. George F. Stitch, the vice-president of the company, was in attendance.

The Card Electric Co., Mansfield, O., had an excellent exhibit of its equipment that attracted much attention from street railway men. A single motor equipment, and a heavy double equipment for interurban traffic were shown. A controller for both single and double equipment was also exhibited, together with a pneumatic switch for heavy service. Reid Carpenter, president of the company, John F. Card, superintendent, and George F. Card, electrician, were present.

The Consolidated Car Heating Co., Albany, N. Y., had an exhibit of street car heaters that attracted much attention from everyone present. Heaters were shown in operation under car seats so that everyone had an opportunity of actually testing the efficiency of the heaters. Besides the heaters in operation a number of heaters were exhibited showing their construction. The interests of the company were well taken care of by E. A. Smith, general agent, Jas. F. McElroy, consulating engineer, and H. R Ransom, eastern agent.

The Pennsylvania Steel Co., Steelton, Pa., made a complete exhibit of street railway special work, consisting of girder rails, T rails, and solid cast steel special work. The striking feature of the exhibit was a pyramid of steel rails. This company makes 150 different sections for street railways running from 12 to 120 pounds. The company was well represented by Edmund N. Smith, treasurer, Philadelphia; Jno. F. Ostrom, general agent; Chas. S. Clark, Boston; Mason D. Pratt, engineer; the exhibit being in charge of Chas. W. Reinvehl.

The H. W. Johns Manufacturing Co., New York, made a very neat exhibit of insulating materials and its other various specialties. The location of the company was conspicuous and attracted much attention. Among the things shown were samples of vulcabeston, controller parts, moulded mica, trolley line insulators, weather-proof sockets, etc. The interests of the company were well looked after by Mr. W. F. Crane of the New York office, together with H. G. Issertel. J. W. Perry of the Philadelphia office was also present.

The General Electric Co., New York, made a very large and creditable exhibit. A prominent feature of the exhibit was the G. E. 800 motor connected up and operated by a form K. controller, thus showing the principle of the latter, and it attracted much attention. The company also showed car equipment parts, generator and feeder panels, total current cut-outs, underground feeder tubing, models of joint boxes and caps were displayed together with line material. Ten Thomson '93 arc lamps for use in car houses using 500 volt current were also exhibited. A large amount of literature descriptive of the many pieces of apparatus of the company were generously distributed. Among the material was also a portable Thomson recording wattmeter for testing purposes. The representatives of the company present were W. J. Clark, general manager of the railway department, J. R. Lovejoy, A. K. Baylor, H. C. Wirt, T. P. Bailey, H J. Crowley, W. H. Hoffman and W. C. Potter.

The Walker Manufacturing Co., Cleveland, occupied a most prominent position at the main entrance of the convention hall. The exhibit made by the company was one that attracted universal attention and was especially creditable in the showing made of heavy equipments. In the exhibit was shown a 200 K. W. power generator connected to run as motor, current being supplied from the street railway lines to operate it. A single motor was also shown insulated on a stand running open to allow inspection and illustrate the method of removing the armatures. Other appliances such as fuse boxes, lightning arresters, cut out switches, etc., were shown. In addition to the electrical exhibit models of the company's well-known cable machinery were displayed. The space was decorated by photographs, signs, etc. The representatives of the company present were S. H. Short, W. H. Bone, B. M. Barr and J. M. Atkinson, of Cleveland, H. McL. Harding and R. N. Baylis, of New York, and G. A. E. Kohler and F. W. Kohler, of Chicago.

The Westinghouse Electric & Manufagturing Co., Pittsburg, was well represented at the convention. Those present were W. C. Clark, E. H. Heinrichs, G. A. Rutherford, and A. J. Wurtz, of Pittsburg, G. Pantaleoni, of St. Louis, W. F. Zimmerman, of New York, B. F. Stewart, Chicago, R. S. Brown, Boston; also D. A. Tompkins and J. R. Gordon. The headquarters of the company were at the Hotel Aragon, while the practical exhibit it made consisted of two 400-horse power generators and one 167-horse power generator direct connected in operation at the power plant of the Atlanta Consolidated Street Railway Co. Also nine double 30-horse power equipments in operation on the lines of the company. On the Atlanta Traction Cos'. lines were also in operation eight double equipments. In addition to this the company made a joint exhibit with J. G. Brill Co. of one double equipment on a special car and one equipment of three motors on a snow sweeper. Also one double equipment on a Jackson & Sharp car besides one pair of motors mounted on a Baltimore Car Wheel Co. Truck.

The Review of Reviews for November contains its usual valuable records of current events under the title of the Progress of the World. Of the special articles in this number that concerning Oliver Wendell Holmes, by Edward Everett Hale, is of especial interest to Americans. The different pictures which accompany the article, recall pleasant memories to those who were so fortunate as to have had a personal acquaintance and will be studied by those who knew him only through his work and reputation. The "leading articles of the month" are reviewed in a careful and interesting manner.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Cripple Creek, Colo.—The Fremont Electric Light & Power Company will double its present capacity January 1 next. C. F. Tingley is purchasing agent.

Ouray, Colo.—The Ouray Electric Light & Power Company is constructing a new and extensive water power. F. A. Sparks is purchasing agent.

Atchison, Kan.—The Atchison Railway Electric Light & Power Company is now constructing its plant. H. A. Odell, Chicago, is purchasing agent.

Frostburg, Md.—The Frostburg Electric Light & Milling Company may add a 1,000-light alternating dynamo. E. S. Corbett is purchasing agent.

Buena Vista, Colo —The Buena Vista Electric Light Company will add an engine, boiler and dynamo. C. L. Graves is secretary.

Greenville, Tex.—The City Electric Light Company will add to its equipment a 300 horse-power engine, a 1,000-light incandescent dynamo and increase its arc capacity. Frank Moffett is purchasing agent.

Pekin, Ill.—The city of Pekin is adding to its equipment an arc and incandescent dynamo and also an engine. Thos. Cooper is purchasing agent.

Covington, Ky.—The Suburban Electric Company contemplates the addition of an engine, an arc and incandescent dynamo. J. C. Heaton is purchasing agent.

Osage, Ia.—The Osage Electric Light, Heat & Power Company is building a new plant, to be operated by water power. James A. Smith is purchasing agent.

Marion, Ind —The Marion Electric Light & Power Company will increase its arc plant and add a motor circuit. M. Dickinson is superintendent.

Argentine, Kan.—The Argentine Water & Electric Works Company will add 6 public arc lights and one mile of circuit.

Cambridge City, Ind.—Borden & Sears have just completed their new light station.

Anna, Ill.—C. Nordling & Son (successors to Anna Electric Light Company) will add an arc plant by January 1 next.

Herington, Kan.—H. S. J. Towner has leased the municipal plant for 25 years.

Elmwood, Ill.—The Elmwood Electric Light Company will extend its circuit 3 miles to Yates City. E. L. Brown is purchasing agent.

Jerseyville, Ill.—The Jerseyville Electric Light, Gas & Power Company will add two new dynamos. John A. Shephard is purchasing agent.

Baxter Springs, Kan.—The Baxter Springs Light & Power Company may put some arc lamps on its incandescent circuit. B. S. Warner is purchasing agent.

Baltimore, Md.—The Maryland Safety Light, Heat and Power Company, incorporated by Jos. Knell, Henry C. Barranger, E. C. Wallman, Geo. W. Knoll, and R. D. Bradley. Capital stock, $50,000.

Lebanon, Ky.—The Lebanon Electric Light & Ice Company contemplates the additiion of a 100 horse-power engine, an arc dynamo and lamps. J. M. Treber is purchasing agent.

Belle Plaine, Ia.—The Belle Plaine Electric Light Power Company is rebuilding its plant which was recently destroyed by fire. S. S. Sweet, owner.

Cadillac, Mich.—The Cummer Electric Light Company will add a 500-light alternating dynamo. W. W. Cummer, owner.

Nantucket, Mass.—The Nantucket Electric Light Company has been sold to its bondholders. A new company will probably be organized. J. R. Bacon is agent.

Chillicothe, Ill.—The Chillicothe Water, Electric Light & Power Co. has recently installed a 27 Kw. alternator, made by the Standard Electric Co., Chicago, Ill., and are now busily engaged extending their line service.

Cape Girardeau, Me.—The Cape Girardeau Water Words and Electric Light Company, incorporated by T. W. Gannon, Patrick Fitzpatrick, L. J. Albert and others. Capital stock is $100,000.

Buffalo, N. Y.—The Niagara Falls Electric Light and Power Company, at a meeting held recently, elected Hon. Walter P. Horne, vice-president. They also decided to build an addition to the present building, to be used for office and storeroom purposes.

FINANCIAL.

Considerable activity has been noticeable in the stocks of electrical companies during the past month. General Electric has been the target and the stock has been down and up, but mostly down. This stock seems to be the plaything for a certain class of speculators and receives an attack about every so often. The stories that are floated about concerning the affairs of the company are not contradicted and so are probably believed by all except those who have a knowledge of the company's business.

Stock of the Westinghouse company has remained firm. The larger part of the stock being held by investors, there is little on the market. The business of the company is keeping the shops busy and night work is frequently demanded to keep up with orders. The shops at Brinton are rapidly approaching completion. Telegraph and telephone stocks are lower.

Trade in electrical apparatus and supplies is generally reported good, several houses reporting the fall trade nearly up to that of previous seasons. Prices, however, fail to go up. Railway construction work now going on makes a good demand for railway materials.

The accounts against T. W. Ness & Co., of Montreal, who recently made an assignment, were purchased last month, by Mr. Rankin for 30 cents on a dollar.

The stock of Taylor, Dee & Mack is being sold out by the assignee. On October 26 an application was made to the court by the committee of creditors of the Knapp Electrical Works to have the appointment of the receiver set aside because Mr. Lucas was a debtor to the company. The application was denied by the court but would be granted upon a petition signed by three fourths of the creditors.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING Oct. 25.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	198½
" " "	Bds. 1898.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co... ...	Com.	14,000,000	100	..	....	90
Commercial Cable Co	Com.	7,716,000	100	...	....	125
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	...	F. Q.	120
" " " ...	C. Bds. 1898.	71,000	100	6	M. & S.	.....
" " "	C. Bds. 1901.	586,500	100	6	M. & N.	.....
" " Brooklyn..	Com.	2,500,000	100	...	Q. F.	85
" " " ..	1st. 1940.	500,000	100	5	A. & O.	100
" " " ..	Regis.	....	100	5	A. & O.	.....
" " Chicago...	Com.	3,000,000	....	8	Q. F.	135
" " "		2,500,000	....	....	....	.....
" " New York.	Com.	7,9[illegible]8,000	100	...	Q. F.	101½
" " "	1st 191[illegible].	2,562,000	100	5	M. & S.	107
" " Phila......	Com.	1,473,000	100	...	....	122
" " "		....	....	5	....	.....
Fort Wayne Elec. Co...... ..	Com.	4,000,000	25	....	....	2¼
General Electric Company.	Com.	30,457,000	100	...	......	35½
" "	Prf'd.	4,251,900	100	...	....	65
" "	Deb. 1922.	10,000,000	100	5	J.-D.	88
Gold & Stock Tel. Co....	Com.	5,000,000	100	....	Q. J.	103
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	90
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	....	......
Thomson European Welding Co.	Com.	1,500,000	100	..	....	......
Thomson-Houston Elec. Co . .	Series D.	1[illegible]0,000	10	...	....	5⅜
Thom'n-Houst'n Intern. Elec. Co.	Com.	600,000	100	.	....	.....
" " " "	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co....	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q. J.	83
" "	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass' ing.	5,333,940	50	....	......	35½
" " "	1st Pf. Cum.	3,755,700	50	7	....	52½
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R.............	Com.	6,000,000	10	...	Q.-J.	170
" "	1st Bds. 1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	...	Oct. 1.	.....
" " " ..	1st Bds. 1909	200,000	100	5	J. & J.	90
" " " ..	Certf. 1894.	300,000	100	6	J. & J.	100
BUFFALO—						
Buffalo St. Railway.............	Com.	5,370,500	100	5	....	57⅓
" "	Bds. 1931.	5,000,000	100	....	F. & A.	100
BOSTON—						
West End St. Railway..........	Com.	9,085,000	50	..	J. & J.	47
" "	P f'd.	6,400,000	50	5	J. & J.	77
" "	Bds. 1902.	3,000,000	100	....	M. & N.	100½
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	...	....	33
" "	Prf'd.	1,000,000	100	5	A. & O.	85
" "	1st Bds. 1930	6,000,000	100	....	J. & J.	......
NEWARK, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	...	....	27⅜
" "	Bds. 1930.	6,000,000	100	5	J. & J.	93⅛
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	155
" "	Bds.	2,000,000	100	...	....	98
PITTSBURGH—						
Duquesne Traction Co........ ...	Com.	3,000,000	50	...	....	26½
" "	Bds. 1930.	1,500,000	100	5	J. & J.	103
. St. & Pleas. Val. R. R.......	Com.	1,400,000	50	....	J. & J.	20
" " " " "	Bds. 1919.	1,250,000	100	5	J. & J.	102
ittsb'gh, Aleg. & Man. R. R.....	Com.	3,000,000	50	....		37
" " "	Bds. 1931.	1,500,000	100	5	J. & J.	103¾
Pittsburgh & Birming. R. R.....	Com.	3,000,000	25	....	......	12½
" " "	Bds. 1929.	1,500,000	100	5	M. & N.	95
ROCHESTER—						
Rochester Railway Company.. .	Com.	5,000,000	100	...	....	67
" " "	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway..............	Com.	2,500,000	100	....	Q.-J.	99
" "	Bds. 1910.	1,500,000	100	5	J. & J.	102
St. Louis & Suburban...........	Com.	2,500,000	400	....	.... ..	17
" "	Bds. 1921.	1,400,000	100	6	F. & A.	105
Union Depot Railway..........	Com.	1,200,000	100	...	....	100
" " "	Bds. 1910.	1,000,000	100	6	A. & O.	105

NEW BOOKS.

Practical Notes on Rope Driving. By M. E. New York, 1894: Street Railway Publishing Company, 26 Cortlandt St. Paper, 50 pages; price, 50 cents.

The publishers have placed in a convenient form the articles on this subject which have appeared in the Street Railway Journal. This method of power transmission, although in the elementary form very old, has recently grown in importance and value until it is now used in a large number of the largest power houses in the country. Engineers have recognized the advantages of the method and have developed the system by overcoming the defects until, for economy and efficiency, it is now unsurpassed. This work covers the system in its different parts, its advantages, the principles of its operation, the ropes used and best adapted to the work, the design and construction of pulleys, especially of the grooves to secure the best results, and the cost of rope-driving plants. The matter is well written and is made up in convenient form. The contents are especially valuable to engineers, superintendents and managers of power plants, and particularly to owners. The chapter on "Splicing and Care of Ropes" contains information that will aid in prolonging the life of the rope and in increasing the work which the rope will do. The lubrication of ropes is also treated in this chapter, and as it is through ignorance on this subject that the life of the rope is often greatly shortened it will be read by all who have such systems in charge.

Central Station Bookkeeping and Suggested Forms, with an appendix for street railways. By Horatio A. Foster. New York, 1894: The W. J. Johnston Company, Ltd., 253 Broadway. Cloth, 150 pages; price, $2 50.

As the title indicates, this work is devoted to the accounting departments of central stations and railways, which is one of the most important departments in their operation. In proportion to the care that is taken with the keeping of the accounts, the classification of the expenditures and income, may we judge of the thoroughness of the management. The numerous forms and outlines included in the volume for different accounts, etc., are such as should attract the attention of managers. A complete scheme is outlined for the organization of the accounting department of central station and railway companies, and such a plan for conducting the accounts as will enable the management to determine at any moment the condition of business and the unit cost of the generation and distribution of current. The author, through his connection with the industries, has been enabled to examine the methods of hundreds of companies, from which he has been able to study the present practice and to devise methods such as will be found the best adapted to the work. Many of the forms inserted in the book are the actual size used, and others are accompanied by notes suggesting the best size of form for use. In times like the present, when the margin of profit is extremely small and the business of the company has to be run in a most careful manner, it is necessary that the cost of operation should be so kept that every item of expense can be inspected and the cost of production fully worked out. The book contains much of value to the accountant and the manager of lighting and power stations. The volume is well bound in cloth and printed on good paper.

TRADE PUBLICATIONS.

The Landscape Architect is a new publication which has just appeared with the October number. It is published by the Vista Publishing Company of Rochester, N. Y. The first number promises an excellent journal devoted to this industry. The paper is well gotten up with neatly designed headings and clear, bold type, the press work is good and the excellent quality of paper used brings out the half-tone engravings. Although some of the matter might have given place to more valuable subjects, there are many well written and interesting articles.

The souvenir number of the Street Railway Journal, which was published in honor of the tenth anniversary of that journal, is undoubtedly the largest and most elaborate number ever issued. The articles it contains are interesting and timely. The illustrations, which are very numerous, are excellent in every respect. Considerable space is devoted to the American Street Railway Association and Atlanta, where its thirteenth annual convention has just been held. The street railways of the southern cities are described and illustrated, some 30 pages being taken up.

Catalogue and price list of mica, issued by Eugene Munsell & Co., 218 Water St., New York, contains extensive lists, telegraph code, illustrations of the standard forms for commutator segments and other electrical purposes, etc. Mica of many different mines and corresponding grades in sheets or cut to sizes, is imported and mined by this firm, which through its long connection with the industry is well known to the trade. The quantity of mica used has increased from year to year as the industry has grown in importance. This catalogue is attractively gotten up and is printed in red and blue ink, the telegraph code words appearing in red and the sizes and prices in blue.

A pamphlet entitled "Data Concerning Platinum," etc., has recently been sent out to the trade with the compliments of Baker & Co., refiners of gold, silver and platinum, of Newark, N. J. It is of interest not only as a catalogue, but also for the numerous tables which have been compiled by Baker & Co. on weights, lengths, etc., comparative tables and information regarding the care and use of platinum utensils, etc. Besides the manufacture of platinum in wire and sheets for electrical and other purposes, the company manufacture an extensive line of platinum goods as used in the laboratory or in the factory. In the center of each page of the catalogue the imprint of the company is printed in color.

The subject of lightning arresters of the Ajax variety is well covered in a pamphlet recently issued by C. S. Van Nuis of 136 Liberty St., New York. The contents are well written, the cuts clear, the paper of fine quality and the printing of an equal standard of excellence. The Ajax multiple lightning arrester is described as to its design, construction and operation. The advantages of having a fuse of such a construction, that it is always ready for use and when used gives place to another, are explained. It is possible for the fuse to be exceedingly sensitive as it is called upon to act but once. These arresters are designed for central stations, isolated plants, electric railway and power lines. The method of installation is clearly shown by means of numerous cuts and drawings.

"Some Electrical Specialties," manufactured by The Butler Manufactured Company of 46 and 48 S. Clinton street, Chicago, are illustrated in a pamphlet recently issued by that company. The specialties are such as are used in large quantities by central stations and street railway companies. An extensive line of hoods for arc lights and other arc light apparatus are listed. Such a variety of styles is shown as is sure to meet the ideas of station men. The improved devices for interior lighting, both arc and incandescent, are manufactured. The street railway lighting goods cover those lines where the different kinds of lighting are in use. Head lights for either oil, gas or electricity are made in different designs and sizes. Lineman's and repairers' tools and apparatus and station goods are some of those which appear in this pamphlet. It is of a size convenient for the pocket and its contents are well arranged.

The review of the industrial press inaugurated in the October number of the Engineering Magazine will be greatly appreciated by its readers. The plan of this department is to do for industrial literature all that the Review of Reviews does for the political and literary fields. The department will add greatly to the value of the magazine, and will be appreciated by its present readers and many others whose work and reading are at present greatly hindered for want of such an index and review. The industrial press is too great to be searched by any worker, and the time consumed in glancing over the journals that may come under his hand is often looked upon as lost, since it could be more profitably spent on the subjects which interest him if he had some quicker means of finding them. The above magazine will now furnish the means and will be esteemed not only for its own valuable articles, but as an index and reference book.

The department of electricity and electrical engineering of the Armour Institute, Chicago, is set forth in a pamphlet published by the institute for 1894-5. The work covered by this department is described and the preparation of the student before taking up this course. Such a training both in theory and practice is contemplated "in the hope that students may upon its completion be immediately available for commercial work, and that it may by careful and conscientious conduct in a great measure bridge over the hiatus between the school on the one hand and the electrical factory, central station, or usual engineering practice on the other." Mechanical and steam engineering and machine shop practice are given due prominence in the course. Work is also provided for such as desire to carry forward the line of study under the guidance of the institute. The institute has been very fortunate in securing an admirable equipment, selected by the director of the department, Prof. Wilbur M. Stine.

Street railway managers and construction men will find the new street railway catalogue of the Metropolitan Electric Company (186-188 Fifth avenue, Chicago) a compendium of street railway material. The line of supplies and construction material seems to be complete. New appliances and specialties as well as the standard goods appear. This catalogue is issued as a companion to the large catalogue of general electrical supplies published earlier in the year. It is a volume of over 200 large pages and is full of illustrations, descriptions and lists of street railway goods. Although this company has but recently entered this field the character of the goods offered and the agencies conducted shows that the company understands the wants of its railway customers. In addition to a varied and complete line of power-house supplies and material an extensive stock of overhead and track material is listed. The well-known and extensively used P. & B. paints and compounds are included in the stock of insulating material carried.

Two pamphlets of interest to the electrical trade are being distributed by the Electric Appliance Company of 242 Madison St., Chicago. These are the first of the kind covering the particular lines of goods and will undoubtedly be appreciated by the trade. Packard transformers are illustrated and described as to process of manufacture and details of construction. Data is also given regarding the efficiency, regulation and much other matters of interest. The other catalogue covers the complete line of Packard lamps from "Baby" to "Mogul," and the many appliances manufactured at the Packard works for use in connection with these lamps. The Packard theater lamps for foot, border or bunch lights are listed for the first time. The Packard stereopticon lamp which is used in place of the old-fashioned calcium light and the focusing outfit for use with same, are also listed. It is also filled with information relative to these subjects. The Appliance company has endeavored to reach every one interested with a copy, and if you have not received them the company, if notified, will forward them by the next mail.

PERSONAL.

Mr. W. H. McKinlock, president of the Metropolitan Electric Co., was absent for several days last month on a business trip to New York.

Mr. Fred. Standish Kenfield, of the Chicago firm of Windsor & Kenfield, publishers of the Street Railway Review and Brick, was married on October 24th to Miss Amy Sweeney, daughter of Edward D. Sweeney. The wedding took place at the residence of the bride's parents in Rock Island, Ill. The residence was handsomely decorated and many rich and handsome costumes were worn by the bridal party. The ceremony was performed by the Rev. F. W. Merrill. Mr. and Mrs. Kenfield left the same evening on a trip through the south.

BUSINESS NOTES.

LEE & COLLINS, formerly in the Medinah building, Chicago, are now located at 239 La Salle St. The line of goods carried comprise batteries and battery material, compound and insulating material, and a general line of electrical supplies.

THE CHAS. E. GREGORY CO., Chicago, reports a list of sales for last month which limited space will not permit us to give in detail, but it includes no less than 34 dynamos and 12 motors ranging from 1 to 80 K. W., and from 1 to 105 horse-power capacity. The company also sold some 185 arc lamps besides having an especially large demand for smaller appliances and material.

Eighteen new Allgemeine volt meters were also sold, which the company imports for the benefit of its trade. The total business of the month done was highly satisfactory, it being larger than that of any previous month in the history of the organization.

THE STANDARD ELECTRIC COMPANY, Chicago, Ill., recently installed an alternator in the plant of the Chillicothe Water, Electric Light & Power Co., of Chillicothe, Ill. These new machines are meeting with favor among central station men. The company reports a large number of orders ahead for the well-known Standard arc dynamos.

THE WATERTOWN STEAM ENGINE COMPANY, Watertown, N. Y., recently closed a contract with the Cortland & Homer Traction Company, for four 100 horse-power boilers and four compound condensing Watertown engines with pumps, condensers, heaters, etc. The specifications were drawn and contracts placed under the direction of Prof. R. C. Carpenter, of Cornell University.

THE METROPOLITAN ELECTRIC CO., Chicago, finds its business constantly increasing. At present the company is selling large quantities of N. I. R. and I. X. L. wires, besides increased orders for all its other specialties. Mr. W. C. McKinlock, the secretary of the company, just returned from a very successful trip in which he closed some important orders for the transformer made by his company.

THE OKONITE COMPANY, LTD., 13 Park Row, New York, reports that the sales of its well-known brand of wire for the past month, exceed those of any previous month during the current year. This is certainly encouraging, as it shows that the improvement in the business situation continues and that the excellent fall trade promised is being realized will give encouragement for the future.

THE CENTRAL ELECTRIC COMPANY, 173-175 Adams St., Chicago, after making exhaustive tests of the B. & S. compounds and paints, has accepted the general western agency. The careful tests made showed these products to be of the first order as regards their insulating qualities and the company will carry a large stock. These goods are already appreciated by the trade as the number of orders received shows.

THE OHIO BRASS COMPANY, Mansfield, Ohio, has given considerable attention to the manufacture of railway motor bearings and the company now numbers among its regular customers for these bearings some of the largest roads. The bearings are made of bell metal and are turned and milled by special machinery. The care taken in finishing insures a perfect fit and an even and smooth bearing for the shaft.

THE BALL ENGINE CO., Erie, Pa., report among recent sales an engine to the City of Morganfield, Ky., for a municipal lighting plant; a 150 horse-power engine to the Freeport Electric Railway, Freeport, Ill.; a 150 horse-power engine to the Lebanon Electric Light & Power Co., at Lebanon, N. H.; two 350 horse-power vertical compound engines to the Camden Horse Railway Company, Camden, N. J.; an engine for the George W. Childs Public School Building, Philadelphia, which is now being installed by J. W. Parker & Co., the Philadelphia representatives of the Ball Engine Company and the engines for the lighting plant in the North Sub-District School, of the Fourth Ward, Pitstburgh.

THE WALLACE ELECTRIC COMPANY, 307 Dearborn street, Chicago, has recently made arrangements to handle the entire output of the manufacturers of the Brilliak lamp. This lamp has been subjected to some very severe tests under various conditions and the Wallace company claim for it high efficiency and economy in operation. For railway work it is made with an anchored filament so as to withstand the severe conditions which lamps are subjected to. The specialties handled by the Wallace company, among which are the Hope arc cut-outs, arc lamps manufactured by the Electric Construction & Supply Company, Iona switches, sockets and cut-outs, Habirshaw wire, and others, are well known to the trade and a full line of these goods are carried in stock for prompt shipment.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison St., Chicago, has secured the western agency of the railway supplies manufactured by the Lynn Mfg. Co. A full line of these goods will be carried, and a special catalogue of electrical railway supplies is being prepared. The company will, in the meantime, be pleased to make estimates or quote prices on anything in that line. The company reports a good run on their Acme expanding wire guard, a specialty of which the Appliance company is the exclusive manufacturer. It is probably one of the most satisfactory wire guards made for the protection of incandescent lamps from mechanical injury. It automatically clamps the socket without the use of a holder of any kind. It is neat in appearance. The company reports also a good trade in supplies of all kinds. Such an excellent run of business is said to look like old times.

GOLDSMITH BROS., 63 and 65 Washington St., Chicago, one of the largest as well as oldest firms of refiners and assayers, make a specialty of purchasing the platinum in old and worn-out incandescent lamps. The offer made by this firm to anyone having old lamps is certainly very fair, and no doubt many who have a collection of old lamp caps or bases will take advantage of the opportunity to make it a source of profit. The firm asks that a sample of the goods be sent for inspection, or, if the customer prefers, the goods can be shipped by freight, and they make immediate returns by draft for the amount due, and if the offer does not prove satisfactory they will return the assignment intact at their own expense. In this case the shipper takes no risk and the good standing of the firm makes the transaction a safe one for him.

OSBURN BROS., 304 Dearborn street, Chicago, have secured the agency for the North British Wire Co., of London, England, who have long manufactured the wire gauze which enters so largely into the wire gauze brushes now extensively used on both dynamos and motors. This company now manufacture the brushes themselves and Osburn Bros. are now carrying a large stock of these goods. Wire gauze dynamo and motor brushes are now always to be had at this house.

THE MOORE ELECTRICAL COMPANY, New York, was recently incorporated. The incorporators and directors are: Leopold Wallach, Joseph Livingstone, Edward J. Wessels and D. McFarlan Moore. These gentlemen are all well known through their business connections and reputations. Mr. Wallach has been counsel for a number of prominent companies; Mr. Livingstone is a banker, Mr. Wessel is general manager of the Genette Air Brake Company, and Moore is well known as an inventor and as the electrical engineer of some of the largest manufacturers of electrical apparatus. He has but recently resigned his former position and will give his entire attention to the affairs of the new company. It is expected that some exceedingly novel appliances will be brought out by this company. Mr. Moore has made many advances in the subject of lighting and his patents are now owned by the new company.

THE SIEMENS & HALSKE ELECTRIC COMPANY of America has certainly shown pluck in its rapid recovery after the fire of August 1 that destroyed its extensive manufacturing works. On August 15, the company took possession of the Grant Locomotive Works. The machinery and tools in the new works were soon put in shape for use and the special machinery of the old works were duplicated and on October 15 the first generator was completed and shipped. The managers of the company were untiring in their efforts to place the manufacturing facilities of the company on an equal or better footing than before the fire. The new works are supplied with every modern facility for the rapid production of electrical apparatus. The company is now in a position to finish one direct connected generator each day. Every department of the company is now on the best footing. Its offices are in every large city and its facilities for rush or special orders are unsurpassed.

THE LOUIS K. COMSTOCK COMPANY, 1437 Monadnock, Chicago, is engaged upon a number of important contracts including the installation of a 250 light plant in the Calumet elevator, the electric lighting of the new State Safety building at the corner of State and Van Buren streets, Chicago, and the lighting equipment of the Detroit Chamber of Commerce building, Detroit, Mich. The first installation west of New York City in which iron conduit is used is being made by this company at the new residence of P. D. Armour, jr., on Michigan Ave. Another electrical installation which is nearing completion is that in the Niagara building at Peoria, Ill. The company has received a large share of the contracts which have been let during the past months when contracts were not at all plentiful, which speaks well for the resources and standing of the company. The company has also a large business as consulting and supervising electrical engineers. The established reputation of the company in this respect is well known throughout the middle and western states, where the larger part of its business is conducted.

The Elwell-Parker Electric Company of America.

The Ellwell-Parker Electric Company of America have begun business, with headquarters in Cleveland, O. They have secured control of very extensive works, which are already well equipped for the manufacture of the heavy machinery which will be the specialty of the concern.

The Elwell-Parker Company's systems in England are under the control of the Electric Construction Corporation, one of the largest and leading concerns in that country. Their English works are at Wolverhampton.

The Elwell-Parker Company in this country will make a specialty of low period direct-connected and belted alternating current dynamos; also the equipment of elevated roads by their electric system, such as is in operation in Liverpool and other places. The Liverpool road is the first road in the world to adopt electricity for the running of their elevated trains, and the results have been phenomenal in economy and ease of manipulation.

They will also make a specialty of the largest sizes of direct-current generators of their well-known types. Their work in Europe is too well known to need mention. Their alternating plant at the Manchester station in London, of 30,000 lights' capacity, is operated by the Willans central valve engines, direct-connected to low period alternating current dynamos. At Madrid, Spain, there is also another very large alternating current plant of their system.

This concern has done a large business in all the European countries, as well as the English colonies. With a large financial backing and fine works, their position as one of the leading companies in this country is an assured fact.

J. Holt Gates, of Chicago, has taken the western agency.

ELECTRICAL INDUSTRIES.

Vol. V. CHICAGO. December, 1894. NEW YORK. No. 12.

The Power Transmission System at the King Powder Mills.

The special attention recently given the alternating current systems of power transmission, has in a measure at least withdrawn public attention from the many advantages of the direct current for the distribution of power. The system is much simpler, and for limited distances fills every condition. It is also maintained by many of the oldest electrical engineers, that the advantages of the direct current for this service will never be equaled by other systems. The most extensive power transmission plant using the direct current system in operation, is that which was recently placed in the mills of the King Powder Company and Peters Cartridge Company at Kings Mills, Ohio, by the Shawhan-Thresher Electric Company of Dayton, Ohio. It is a most interesting installation, as it shows the adaptability of the system to the requirements of the manufacturing plants.

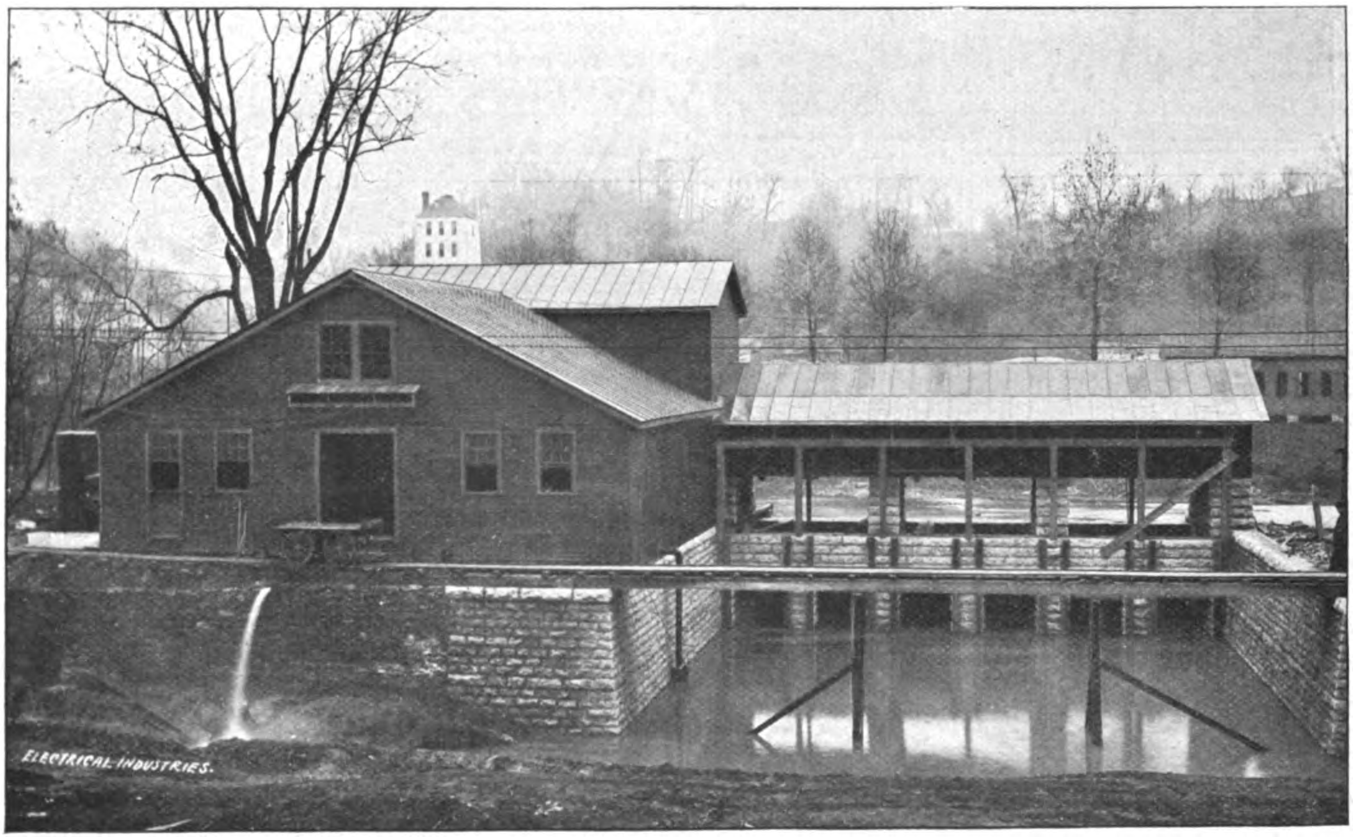


FIG. 1.—THE POWER TRANSMISSION SYSTEM AT THE KING POWDER MILLS—POWER HOUSE.

By referring to Fig. 3, the location of power station and the large number of small building which the character of the business requires, will be noticed. The works are located on both sides of the Miami river and over a considerable territory, distributed within a radius of one and one half miles of the power station. As each separate mill had to be insolated, and must be furnished with power, the methods formerly used of water wheels and numerous steam engines, some of which were located a long distance from the source of supply, were extremely complicated and expensive in operation. They were entirely inadequate to the requirements of the works, while the constant demand for repairs and supplies made it doubly expensive. In the design of the present plant, by concentrating the full power of the water supply at the point of greatest head, a great economy was effected in the power derived from this source. All engines have been done away with, except a reserve engine at the power house. This engine is a 400 horse power, tandem compound Buckeye belted to the main shaft, and is used only in case of accident to water power.

In Fig. 1 is shown a view of water power and station. The wheel plant consists of three turbines of 250 horsepower capacity each, under a 16 foot head. On the main shaft are two Shawhan-Thresher Electric Company's multipolar generators of the direct connected type of 200 kilowatts capacity each, as shown in Fig. 3. They are arranged to operate at a speed of 150 revolutions per minute, and are wound for a potential of 500 volts at no load, and compounded for an increase of pressure of 10 per cent. when operating at full load. These machines are of the very latest and most approved design, and embody in their construction many points of excellence.

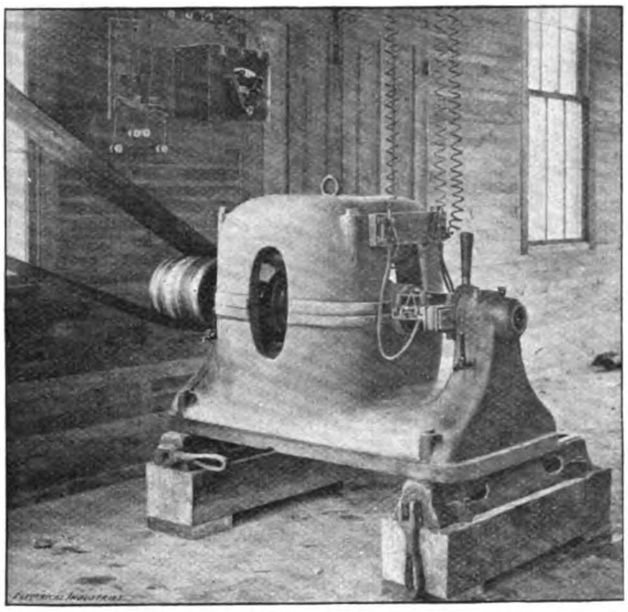


FIG. 2.—THE POWER TRANSMISSION SYSTEM AT THE KING POWDER MILLS—20 HORSE-POWER SHAWHAN-THRESHER MOTOR.

The armature is of the toothed type, each coil being thoroughly insulated and securely held in position. The commutator is of the best tempered copper, thoroughly insulated with mica and clamped together in a compression frame, the end being firmly bolted in position, which renders it very strong and compact. The field coils are wound upon spools, thoroughly insulated and are held in position by an adjustable clamp. The brush holders are firmly bolted to a spider, carried upon the journal box and adjusted by means of a hand wheel and tangent gear. The brushes are carbon, and are automatically kept in constant contact on the commutator with a firm and even pressure. The bearings for these machines are self-aligning and self-centering, and are supplied with oil by double feed, from large oil chambers.

One of the special features of these machines is the method of supporting the armature upon the shaft, which enables it to be kept rigidly in position and yet thoroughly insulated from the shaft. These generators are so proportioned throughout as to obviate any undue heating from a long and excessive load, as the plant is in continuous operation for six days out of the seven without one moment's stop. The generators are connected in multiple to the switch board and the current distributed from thence by six circuits, having metallic return. Each circuit is provided with automatic cut-out and switch to cut it out of circuit in case of accident to that part of plant and not to interfere with the working of the other parts. Upon these six circuits are located twenty motors, situated within a radius of one and one-half miles from the central station, and ranging in size from 20 to 150. For the motors of 40-horse power capacity and below, the well-known iron-clad type of machine manufactured by the Shawhan-Thresher Electric Co., is employed, as shown in Fig 2. This machine, by its compact and simple construction and slow speed is pre-eminently adapted for this class of work. The magnetic material in the field being so placed as to correspond with the lines of magnetic force, reduces the leakage to a minimum and thus gives a very high efficiency. The construction of the frame also affords entire protection to the armature and field coils, from moisture, dirt or abrasion. For the 50 horse-power motors, and over, the multipolar type is employed. Each motor is supplied with an automatic rheostat, double pole switch, safety fuse, and lightning arrestors, as shown in Fig. 5. In the main points of construction, the same general design has been carried out as far as possible in the different types of machines. By means of this method of transmission, the mills are operated smoothly and evenly and the company are enabled to turn out a finished product more uniform in character and with greater economy in operating expenses.

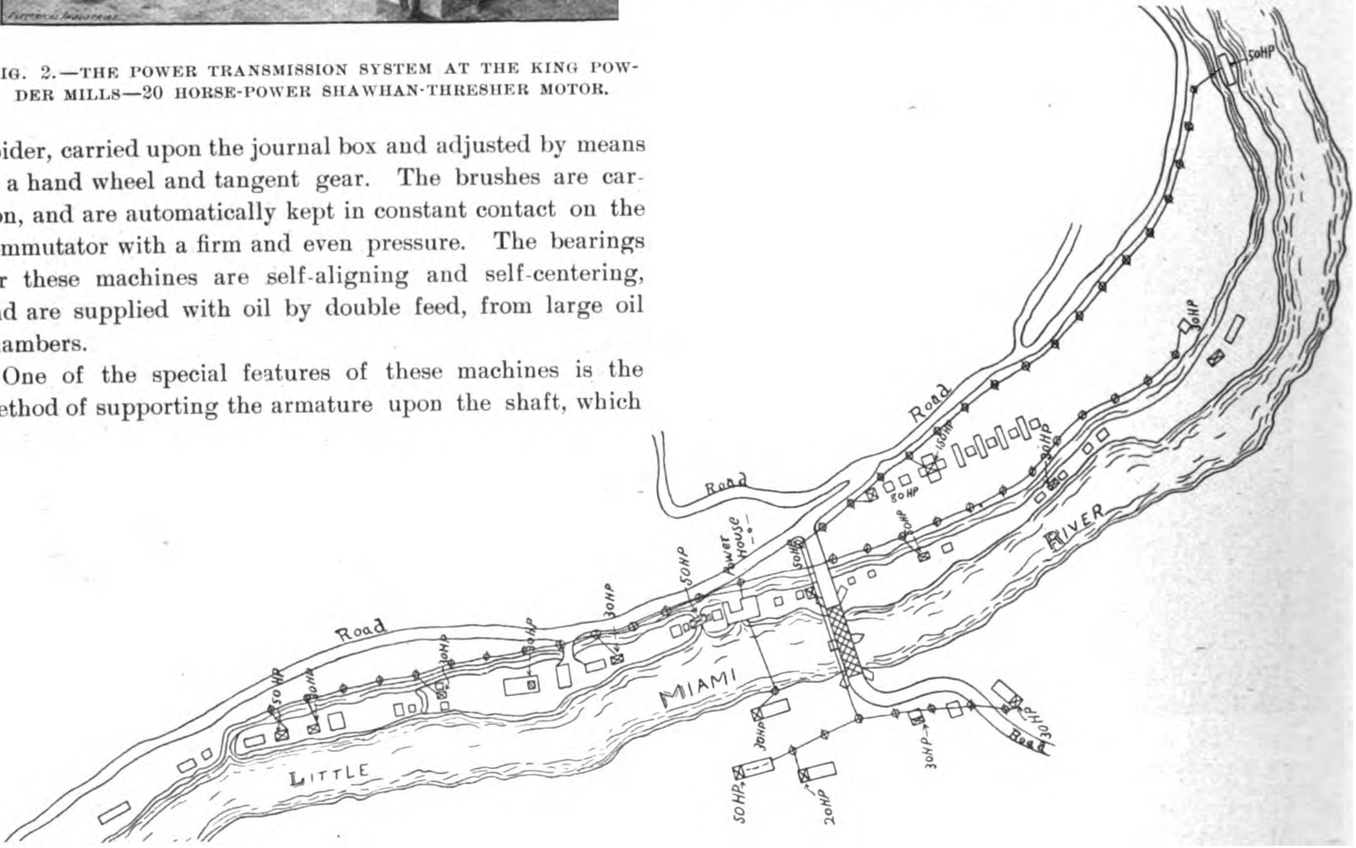


FIG. 3.—THE POWER TRANSMISSION SYSTEM AT THE KING POWDER MILLS—PLAN OF WORKS.

The conduit which is to be used on the extension of the 9th Ave. cable road running on 116th St. and via Lenox Ave. to 146th St. and the Harlem river is to be similar to that used on the cable roads. The object of this design being that should it be desired at any time to change from electric to cable it can be done at the least expense. The conductors, which are channel irons four and one-half by two and one-half inches, are supported one on each side of the conduit by pedestals of soapstone located in the manholes, which are 30 feet apart. The arm which passes down through the slot carries on two sides collectors which press against the two lines of channel irons.

American Institute of Electrical Engineers.

The office of the American Institute of Electrical Engineers, which has been at West Thirty-first street since May, 1890, has been removed to rooms 1009 and 1010 Havemeyer Building, 26 Cortlandt street (10th floor), New York city. The choice of the Havemeyer Building is due to its central location in the electrical district, and its convenience to various lines of travel. It has entrances on Cortlandt, New Church and Dey streets. It is immediately adjacent to the Sixth avenue elevated railroad station, one block from the Ninth avenue station and the Broadway cable line; two blocks from the Pennsylvania railroad ferry, and three from that of the Central railroad of New Jersey.

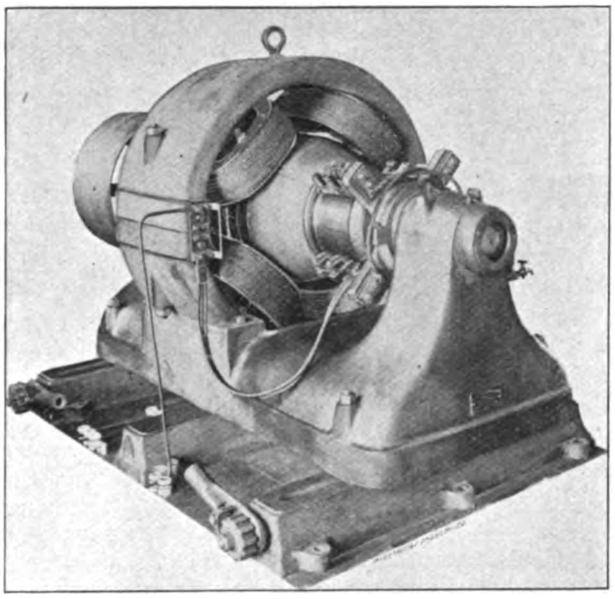


FIG. 4.—POWER TRANSMISSION SYSTEM AT THE KING POWDER MILLS—100 HORSE-POWER SHAWHAN THRESHER MOTOR

The office will be open from 9 A. M. to 5 P. M. It is equipped with a long-distance telephone and district messenger service. Over 100 electrical, mechanical and engineering periodicals will be found on file. The rooms front west and command a fine view of the Hudson river.

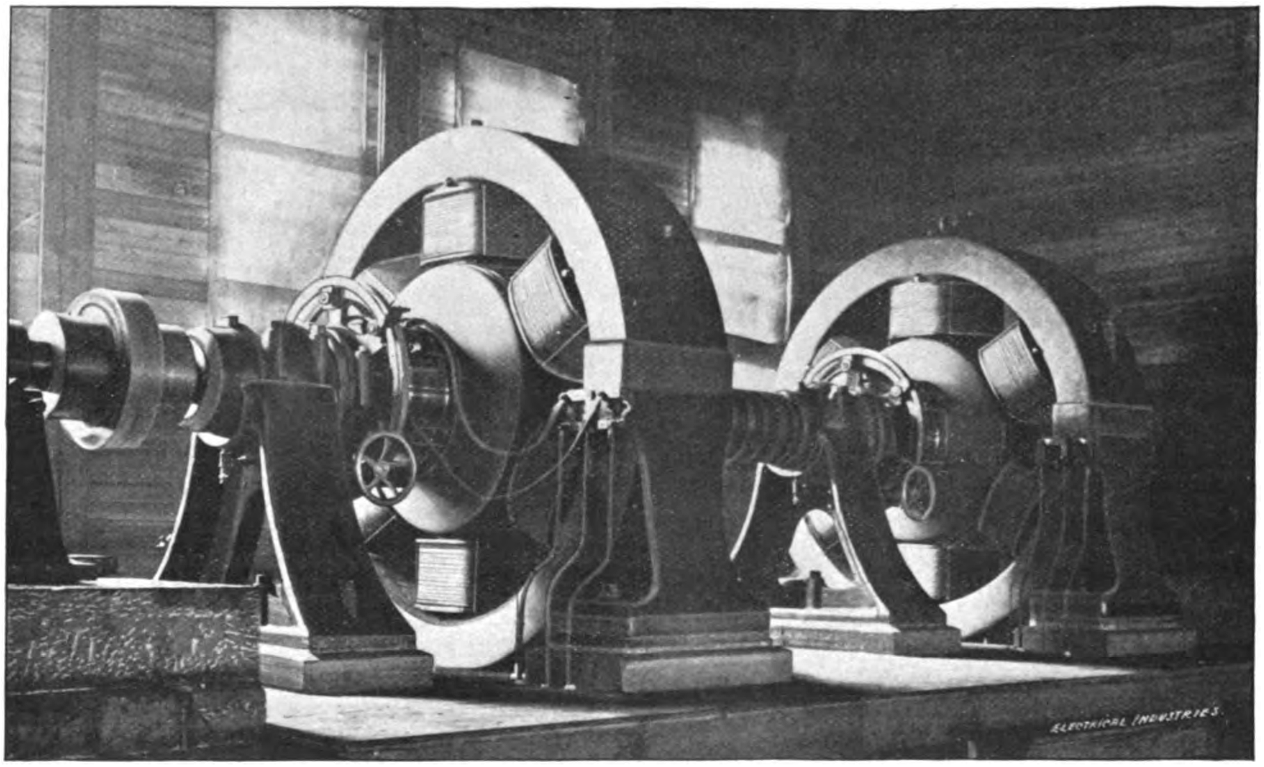


FIG. 6.—POWER TRANSMISSION AT THE KING POWDER MILLS—SHAWHAN-THRESHER GENERATORS.

Report of Western Electric Building and Loan Association.

The seventh quarterly statement of the auditing committee of affairs of the Western Electric Building and Loan Association shows that the success of the association continues. This association was organized about two years ago among the employes of the Western Electric Company for their mutual benefit. Stock is issued in quarterly series at fifty cents per share per month. The total resources of the association now amount to $11,513.85. Receipts for the last quarter amounted to $2,801.19. The officers of the assoiation are: President, C. D. Crandall; vice-president, John Young; treasurer, F. Lancaster; secretary, F. B. Uhrig.

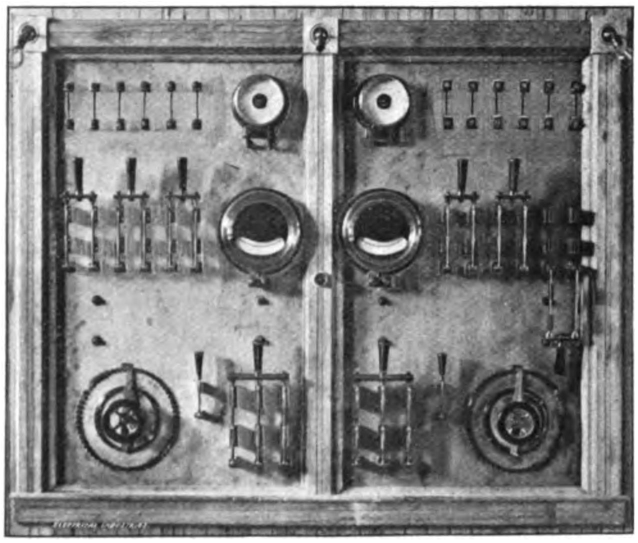


FIG. 5.—POWER TRANSMISSION SYSTEM AT THE KING POWDER MILLS—SWITCH BOARD.

The Alternating Current; Its Generation and Distribution—III.

BY PROF. GEO. D. SHEPARDSON.

It is well known that a magnet is surrounded by a field of force. This may be shown by scattering iron filings upon a piece of glass or cardboard placed over a magnet. When the cardboard is rapped lightly, so that the filings become free to move, they arrange themselves in well defined lines which show the direction of the magnetic force. Fig. 2 illustrates the general direction of the lines about a bar magnet.

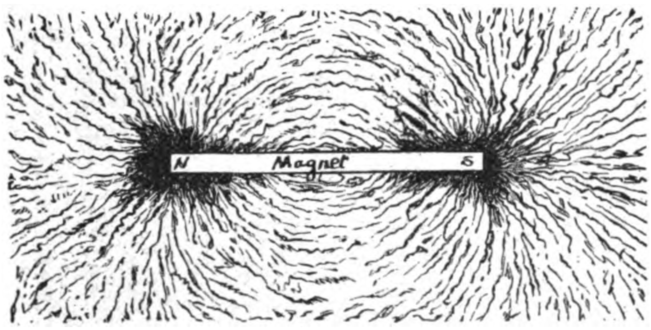


FIG. 2.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

An electric current also is surrounded by a magnetic field. Fig. 3 shows the way in which iron filings arrange themselves about a wire carrying a current. The photograph was taken from a wire passing vertically through a horizontal piece of cardboard, upon which iron filings were sprinkled while a current of twenty amperes was in the wire.

Further experiment would show that the magnetic force about a wire is exactly the same as the force about a bar magnet. In fact, it is understood by scientists that every magnet owes its force directly or indirectly to the influence of an electric current exerted at some time upon the magnet itself or one from which it was magnetised.

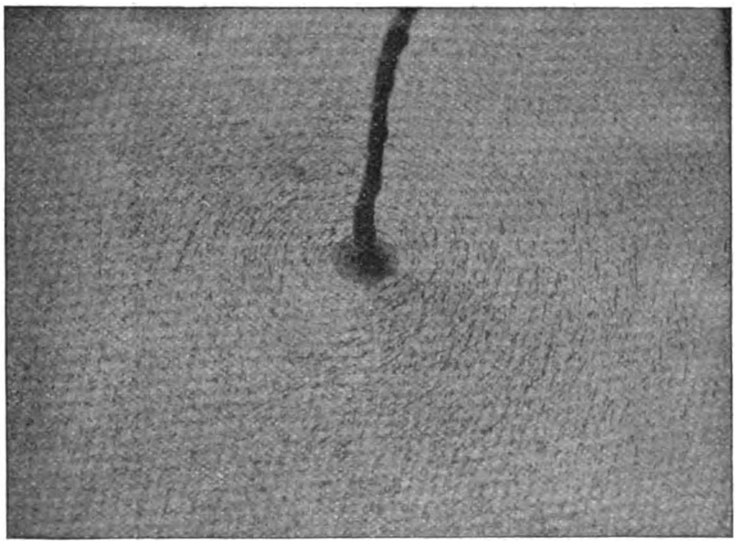


FIG. 3.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

For the sake of convenience and uniformity, scientists have agreed to consider the lines of force as coming out from the north pole of the magnet, that is, the end which points towards the north, and as going into the south pole. With this agreement as to terms, experiment shows that the direction of a current and of the magnetic force surrounding it, bear the same relation to one another as the direction of twist and thrust of a right hand screw. If the direction of either the rotation or the end travel of the screw represent the direction of the current, the other gives the direction of the magnetic force.

The term *line of force* is used to denote both the direction and the intensity of the magnetic field. Dynamo and motor fields often have an intensity of 50,000 to 100,000 lines of force per square inch.

If the wire is wound into a coil, the magnetic fields about the separate turns of wire unite to form a common field as shown in Fig. 4, which was obtained in a similar way to Fig. 3. Iron has many hundred times better conductivity for magnetism than air, and so the magnetic circuits of nearly all electro-magnetic machines are composed, so far as possible, of iron. In dynamos and motors the whole magnetic circuit is of iron, except a small airspace for containing the armature wires and for providing mechanical clearance between the moving parts. In most alternating current transformers the complete magnetic circuit is of iron.

It is a general rule in nature that phenomena are reversible, that is, if a certain action produces a certain result, then the result will, to some extent, reproduce the cause.

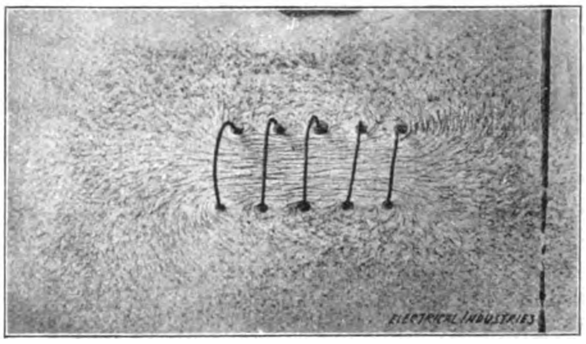


FIG. 4.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

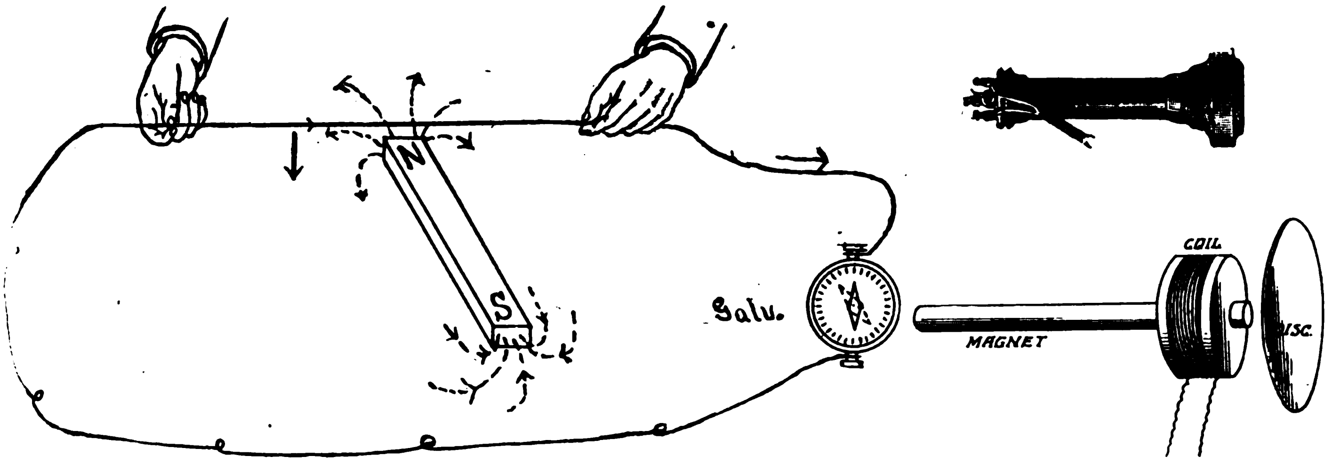
One might expect that if a current produces and is continually surrounded by a magnetic field, then a magnetic field must produce an electric current continually. This is imposssible, because it would mean the actual creation of energy, which is impossible. But it is found to be true that a *motion of a conductor across a magnetic field or of a magnetic field across a conductor, always produces a tendency for current to flow in the conductor.*

Such a tendency for current to flow is call an *induced electromotive force* (hereafter abbreviated to E.M.F.). This may be shown by connecting the ends of a long wire to the terminals of a galvanometer, as indicated in Fig. 4. When part of the wire is moved near the magnet in such a direction as to cross any of the lines of force, the needle of the galvanometer is thrown to one side, showing that a current is passing. The needle is deflected only while the wire is being moved, showing that the current is induced by the *motion.* If the wire remains stationary and the magnet is moved, the needle is deflected in similar manner, showing that the E.M.F. is induced by the *relative motion* of the wire and the magnetic field. It the wire or magnet is moved first in one direction and then the other, the galvanometer needle is also deflected alternately in opposite directions, showing that the direction of the induced E.M.F. depends upons the direction of the relative motion of wire and magnetic field.

A convenient rule of thumb for determining the direction of the induced E.M.F. and the resulting current, is suggested in Fig. 5. Hold the thumb and first and second fingers of the right hand at right angles to each other.

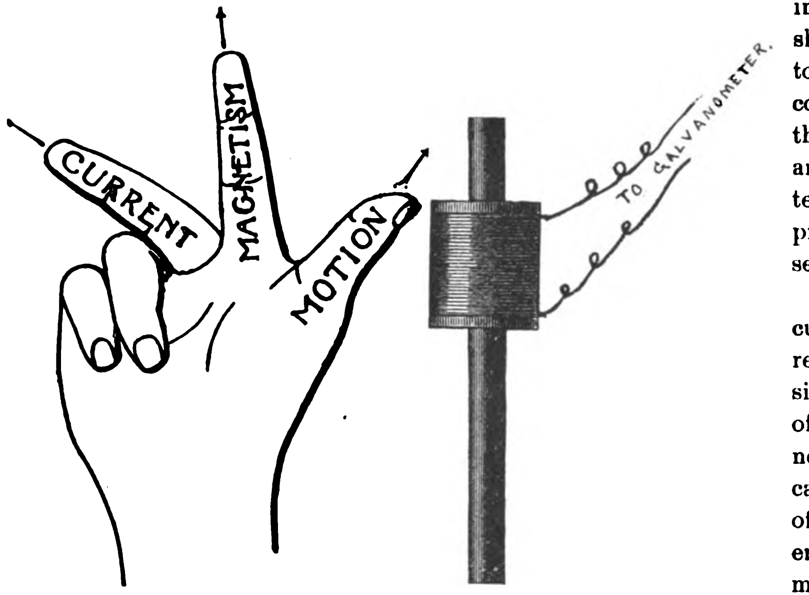
The central finger points in the direction of the resulting current when the forefinger points in the direction of the lines of force, and the thumb points in the direction *to* which the wire moves or the direction *from* which the magnetic field moves. The arrows in Fig. 6 illustrate the rule.

If the wire is moved very slowly past the magnet, the galvanometer needle is deflected but little. If the wire is moved rapidly, the deflection is much greater. The deflection is also greater if the wire is moved at a given speed squarely across the lines of force than if it crosses them obliquely at the same speed. The amount of the deflection also varies when the wire is moved as the same speed in different parts of the field, being greatest where the field is strongest.



FIGS. 5 AND 8.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

If the wire is wound into a coil so as to surround the magnet a number of times, as shown in Fig. 7, the inductive effect is multiplied. More careful laboratory methods prove that *the induced E.M.F. equals the rate of cutting lines of force*. If suitable units be chosen *the induced E.M.F. equals the product of the strength of the magnetic field, the area of the coil, the number of turns of wire, and the velocity of motion in a direction at right angles to the lines of force.* An E.M.F. of one volt is induced when the lines are cut at the rate of 100,000,000 per second.



FIGS. 6 AND 7.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

The E.M.F.'s induced in different parts of the same electric circuit may be in opposite directions. The net or resultant E.M.F. is the sum of the separate E.M.F.'s, each being taken with the proper sign. From this may be drawn the general statement that *the net E.M.F. induced in any circuit is proportional to the rate of change of the number of lines of force enclosed by the circuit.* The net E.M.F. equals the rate of change multiplied by a number of turns or coils in the circuit.

If the north pole of a bar magnet is pushed into a coil of wire, the number of lines of force through the coil is increased until the coil is midway between the poles. An E.M.F. is induced in the coils, tending to send current in a clockwise direction through the coil as viewed from the north pole of the magnet. As the magnet is pushed on through the number of lines of force enclosed by the coil becomes less and less and the E.M.F. induced tends to send current in the opposite directian. Similar E.M.F.'s would be induced if the magnet entered the coil only part way and was then withdrawn. The current induced by such an operation is known as an *alternating or alternate current* since it goes alternately in one direction and then in the other.

A similar alternating current would be induced by moving the coil instead of the wire. Such an arrangement as shown in Fig. 7, is often used in laboratories for bringing to rest galvanometer needles which swing very slowly. A coil is connected to the galvanometer terminals. By moving the coil or the magnet a small amount in the proper direction an induced current is sent through the galvanometer which tends to make the needle reverse its motion. With a little practice one can easily bring a needle to rest in a few seconds, which might otherwise require several minutes.

A somewhat analogous case of induction of alternating currents is found in the action of an ordinary Bell telephone receiver when used as a transmitter. The telephone consists essentially of a bar magnet, a thin diaphragm or disc of sheet iron and a coil of wire placed at the end of the magnet as indicated in Fig. 8. The vibration of the diaphragm, caused by the voice or some other sound, brings the center of the diaphragm alternately nearer to and further from the end of the magnet. The lines of force which leave the magnet at various places near the end, as suggested in Fig. 2, are drawn more or less toward the extreme end by the presence of the diaphragm. The lines of force gather or scatter to a small extent as the variation of the diaphragm brings it nearer to or further from the magnet. The number of lines of force through the coil is thus increased and decreased, and alternating currents of electricity are induced in the coil. These alternating currents are transmitted along the line and the telephone receiver acts as a sort of alternate current motor which causes the receiver diaphragm to vibrate and so emit sounds similar to those at the transmitter end.

Generators of stronger alternating currents will next be considered.

The Chicago North Shore Street Railway.

The Chicago North Shore Street Railway, which has been in operation something over a year, shows favorable returns for the past six months. Although located at a considerable distance from the business part of Chicago it connects a number of important suburbs with the Chicago street railway lines. Most excellent arrangements have been made at its southern terminus for the accommodation and transfer of passengers. Passengers on the Clark St. line of the North Chicago Street Railway for points on the North Shore Railway are carried into the station at the barns, where they transfer to North Shore cars on another track. The cars and tracks are under shelter, a fact that is especially appreciated by patrons in stormy weather. Other accomodations of like nature have encouraged travel on the lines of the road.

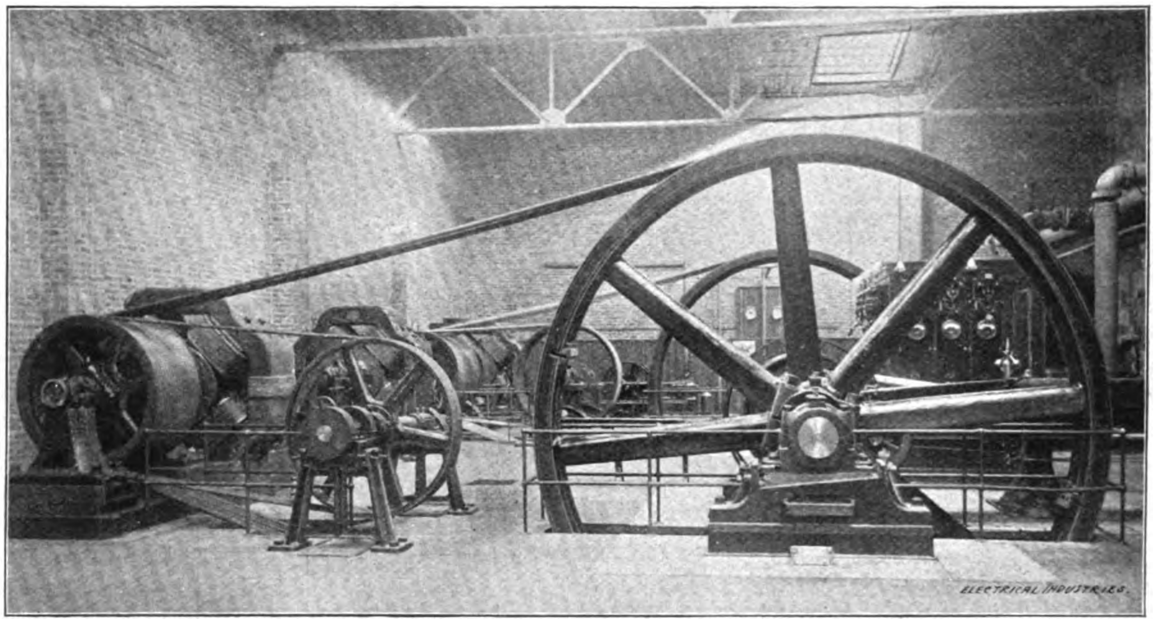


FIG. 1.—THE CHICAGO NORTH SHORE STREET RAILWAY.

It was not expected that the first year's returns would be large, but that some time would be necessary for the advantages of the road to be recognized, and that the residents of the suburbs and districts through which it passes, would gradually come to depend on the electric lines. It has, however, been most liberally patronized from the start and especially during the summer months. The following table shows the relation of operating expenses to earnings, the total number of cars operated, the average number operated during each month, the total number of miles run, the average miles per day, cost of fuel and cost of fuel per car mile for the six months ending October 31, 1894:

	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEPT.	OCT.
Operating expense per cent of earnings..	.804	.621	.606	.4537	.405	.531	.686
Number of cars operated................	276	288	464	793	874	777	618
Average number of cars operated per day	9.20	9.29	15.47	25 58	28.19	25.90	19.93
Total number miles run................	49,110	53,230	65,570	122,960	129,253	113,742	158,727
Average number miles run per day......	1637.	1717.09	2185.66	3963.45	4169.34	3758.07	5120.22
Cost of fuel............................	725 56	690.83	584.10	1180.78	901.95	953 30	1500.30
Cost fuel per car mile........	.01427	.01297	.00890	.00962	.00698	.00838	.00945

In producing the above results the excellent equipment of the road and its careful management have been the controlling factors. The power house was designed with a special view to its economical operation, and the cars and line have been equipped with the latest appliances. The power house, car barns, repair shops and offices are located in one large brick block on Evanston Ave. in Edgewater. The building is two stories in height and contains ample room for the accomodation of the different departments. The offices are located at the north end of the building and are large, well lighted and furnished. The general offices are on the first floor and those of the president and board of directors on the second floor. Immediately back of the offices is located the power plant. The engine and dynamo room is large, well ventilated and is lighted from the skylight in the roof.

The engines are of the Wheelock pattern furnished with the driving equipment by the California Engineering Co., under the supervision of Hoadley Bros, engineers. Two of the engines are coupled to the same shaft on which is mounted a 16-foot grooved fly wheel and the other engine carries a similar fly wheel. These fly wheels are connected to pulleys on the generator shafts by the Hoadley patent compound wind system of power transmission as shown in Fig. 1, and more fully described September, 1893, ELECTRICAL INDUSTRIES. Two multipolar generators of 300 kilowatts each are connected with Hill friction clutches to the pulley shaft while the single generator of the same capacity carries the pulley on its own shaft. The new single engine lately installed is in size 24 by 36 inches, and while 110 running revolutions per minute has developed 750 horse-power. This excellent performance is made possible by every valve having an independent eccentric, the governor controlling the engine for zero to $\frac{7}{8}$ stroke.

At the rear of the engine room is located the boiler room which contains three 250-horse power Heine safety water tube boilers. These boilers are fitted with Hawley down draft furnances and burn crude petroleum. They are most conveniently arranged and there is room for a large addition to the present boiler capacity. An abundance of space is also provided in the engine and dynamo room for any extensions of the present plant.

The car barns, 150 by 220 feet, are in the south half of the building and are divided by a fire wall into two parts. Each track has a trolley above it, so that cars are run in and out by their own motors. Most of the tracks are built with pits so that the motors and connections are easily inspected when cars are in the barn. The cars were built by the Pullman company and are mounted on McQuire Columbian trucks which are equipped with General Electric W. P. motors. The cars are equipped with electric heaters and are nicely furnished and fitted throughout; in fact it is considered the pleasantest of roads to ride on. The cars have Stanwood steps and Adams & Westlake headlights.

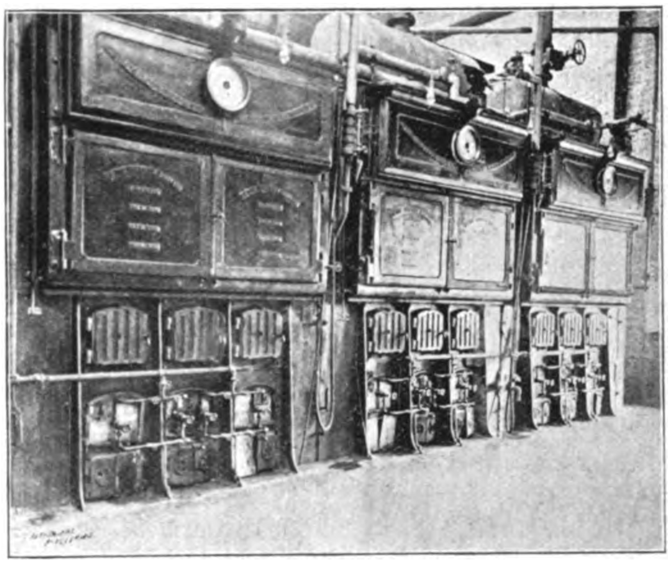


FIG. 2—CHICAGO NORTH SHORE STREET RAILWAY.

The road-bed was well constructed, the track laid with 85-pound Johnston girder rails, banded with 00 copper bands, and the street paved. The side poles are iron, the trolley No. 0 hard drawn copper and overhead appliances of the latest pattern.

The Fort Wayne Transfer.

The Fort Wayne Electric Corporation has finally succeeded in purchasing the real estate, buildings and apparatus formerly operated by the Fort Wayne Electric Light Company. The transfer has formally been made and the corporation is now permanently located in Fort Wayne. It will push the manufacture of its apparatus which is now well known throughout this country.

Fort Wayne had one of the first factories manufacturing electrical apparatus and it now possesses one of the largest in the field. The citizens of Fort Wayne are especially pleased that this corporation has permanently located in that city. On its engineering staff and in other departments are numbers of its esteemed citizens.

Fort Wayne possesses exceptional shipping facilities, being located on the direct line to the east and the west and also having direct connections with the great field to the south and north. The building up of this large corporation has been largely through the efforts of Mr. R. T. McDonald, one of Fort Wayne's most enterprising citizens, than whom no one is better known in the electrical field. The direct management of the manufacturing and sales departments is in charge of Mr. C. S. Knight, a man of wide experience and esteemed by those connected with the industry. The offices of the company, established in all the large cities, gives it most complete facilities for the sale and distribution of goods.

Some Hints on the Building of Electric Plants—I.

BY CHAS. G. ARMSTRONG.

In the building of an electric light or power plant there are perhaps five distinct stages:

First. The Inquiring Stage, in which one determins that they need a plant, and also what kind of a plant, what size, and what nature, and what general method of procedure will be followed in the subsequent installation and operation of the same.

Second. The Specifications, in which a definite plan is laid out for guidance of bidders and constructors. This stage is often totally ignored by owners, almost invariably to their sorrow.

Third. The Installation and Construction period, in which the plant is built.

Fourth. Test and Final Acceptance.

Fifth. The Operation, and some remarks on the publication of the work accomplished.

I mean to describe these in five different articles, the present one being the first, or Inquiring Stage.

This is really the most important stage of the entire installation, as it is the conception of the project and governs largely the success of its subsequent operation by the method and thoroughness with which this work has been done. It is the foundation to the whole structure and if faulty may endanger the success of the structure.

Generally speaking, electric plants do not come by the square foot nor yet by the bushel, although judging by the questions asked by some prospective customers, the popular impression seems to be that an electric plant is a thing that can be purchased like a yard of cloth; is easily put together and always ready to run and give perfect satisfaction, regardless of the duty which it has to perform.

Whereas the average owner, if he intended to build a small building, would consult an architect and would not for a moment think of leaving the various details to the contractor, the average purchaser of electrical apparatus will very often install a plant costing thousands of dollars, depending entirely upon the contractor for advice as to the best methods to pursue. He is often woefully ignorant of the first principles of mechanical or electrical engineering, and either leaves the details to the sellers of electrical apparatus, or places it in the hands of some friend, who may know less of the electrical business than he does himself, depending on him solely, having confidence in his judgment, perhaps from the fact that he has had some remote connec-

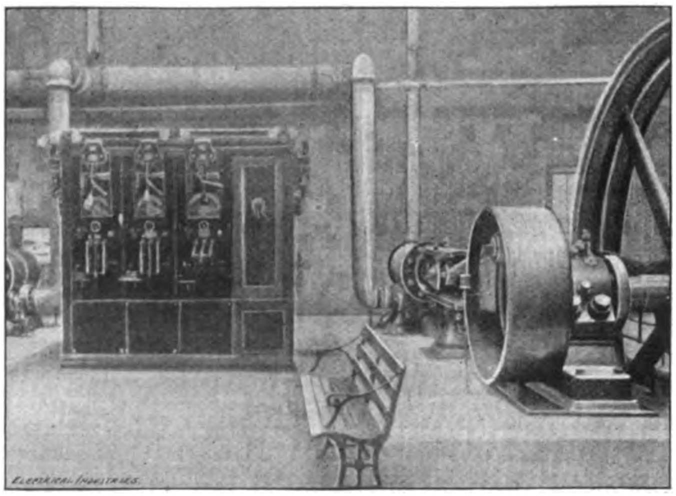


FIG. 3.—CHICAGO NORTH SHORE STREET RAILWAY.

tion with an electric light company, plant, or telegraph system.

Unquestionably, if a man has money, he can buy an electric plant of some kind, but whether it is the kind he wants or not, he will discover after it has been in operation some months, and possibly he may never know the reason why it is not giving satisfaction, or why it is taking more coal to operate than some other plant that has been properly installed.

A serious blunder is often made by large commercial houses and railway corporations in placing the purchasing of electrical apparatus in the hands of the purchasing agent or buyer, whose knowledge of the business has been confined to the successful purchasing of sundry groceries, or dry goods, or railroad supplies, and therefore must be, according to the logic of the owner, the proper person to buy an electric plant.

One instance which has come under my notice was a large department store where it was necessary to repair a faulty plant and enlarge the same. The purchasing agent notified a number of contractors that he wanted to buy an electric light plant and each was requested to submit what he thought they needed. He expressed himself very freely on the question of electrical engineers to the effect that he knew they "stood in" with the electrical companies and obtained commissions from the same. It is indeed no wonder that he had a poor opinion of the integrity of human nature, as he could only see others in the light of his own questionable transactions. This is but one instance in a great many where men without character have been permitted to control the purchase and installation of valuable plants, much to the detriment of the too trusting and overconfident owner. Where the question of buying is left entirely to the salesmen of the different electric companies, the purchaser may or may not receive a satisfactory plant, depending on accident. Generally speaking, the men engaged in the selling of electrical apparatus are men of high standing, brilliant, sharp and shrewd; men who know how to drive a sharp bargain, and men who thoroughly understand the art of placing their own wares. They are, in a great many cases, electrical engineers, who, if they could only lay aside prejudice, could advise a customer very accurately as to what he should use, but unfortunately, in most cases, they are partial to the goods which they handle, their sole object being to obtain the best profits for their company rather than the best interests of their customer.

Then, too, the salesmen representing the different companies get into a rut or channel from which they cannot extricate themselves, such as for instance, the agent for a company handling direct apparatus can see no good in alternating, and vice versa, and would most surely advise the customer to use his apparatus without regard to whether it would meet his requirements or not.

Another class of advisers, who are perhaps as much to be shunned as the purchasing agent, is the theoretical expert, many instances of whose handiwork are visible in various large plants throughout the United States and England. The moment that one of these men get a position they rush into print with an elaborate account of his appointment and enters into a learned discussion with all who will listen to him, of the methods he intends to pursue in order to carry out the (to him) all-important work before him. Every issue of our various electrical journals will contain more or less of an item from his versatile pen, and indeed, like our pugilists, he does his work largely on paper. Every new sub-contract that he lets in his work, every suggestion which he makes, he endeavors to herald over the country. The marvelous (?) work which he intends to accomplish is a matter of general comment, and the result usually is, that after editing intricate formulæ, embracing various Greek and other characters, setting forth minute and accurate calculations the plant turns out to be a failure—is too complicated to run, and after all the time and money has been spent a plain, common sense plant is substituted and successfully performs the required work. A large English plant constructed on this plan is a striking illustration, and an American plant at present in a state of quiescence is another.

Another method pursued by some, for instance, corporations, cities, and large companies, is to send a committee over the country to investigate different plants. This they attempt to do without expert advice, and after visiting various factories and electric light plants, go home with a chaotic idea of the whole electrical question and a much more definite idea of the various amusement halls which they have visited during their trip.

Manifestly the only method to pursue is to employ an expert who is careful in his decisions, impartial, and who has had sufficient technical training, together with practical knowledge, to do justice to all, and yet secure for the owners the best and most modern appliances to accomplish the work he has to perform at the lowest market price for the same.

To build a good plant a man must first know what he intends to accomplish with that plant; the kind of lighting or power he intends to do; the distance his current is to be transmitted; what average load he expects to carry; what would be the proper power to use for his particular service; whether the plant should be alternating or direct; whether he should use arc or incandescent lamps, or both. All of these questions are questions which can only be answered by experience combined with good judgment—a thing which cannot be expected from theoretical experts (?) purchasing agents, amateur electricians, salesmen, or men not familiar with that particular line of business.

The first and most important item of consideration is the available power—water power being the cheapest, but often a very unsatisfactory one to use. This is particularly true of slow moving streams which are liable to clog with ice in winter and run very slow in summer.

If steam power is determined upon, the question is whether some form of Corliss or a high speed engine should be used, depending upon the service required.

The dynamo capacity should be divided in such a way as to work each unit near its maximum output. If these dynamos are direct connected it is extremely important that they should be worked as near their maximum load as possible, as the engine is only economical at that point. In this particular a great many electrical engineers make a grave mistake. We often see a large engine driving two or more dynamos, the object being to get a more economical plant; that is, they will lift the brushes and disconnect one or more dynamos as the load decreases. There is no economy in this whatever. In fact, there is a loss, because we have the slippage of the extra belts and the friction of the boxes, all of which tend to make the production of current more expensive. Even if dynamos are connected to the countershaft driven by Corliss engines, there are limits beyond which it is not economical to go in the subdivision of your dynamos, as the designer should bear the fact in mind, that a dynamo is economical throughout a wider range than the best engine that has ever been built. Few engines are eco nomical below 66 per cent of their power, while most dynamos will show a high efficiency until in the vicinity of $\frac{1}{3}$ load.

I recently saw a plant of considerable note in New York City, where I found eight small dynamos, running continuously about sixteen hours per day, from a counter shaft driven by a 650 horse-power Corliss engine, showed an outpu tvarying from 100 to 1,000 amperes. Eight large boilers were required to keep this plant running and the amount of coal wasted during the year would very nearly, if not quite, purchase a plant which would economically carry the load.

The most practical method of settling the question of maximum and minimum output is to estimate by actual experiments or from practical experience in a similar class of work, the current required during every hour throughout the twenty-four. This load can be plotted in a curve and a plant devised therefrom which would meet the load requirements of each division of time with the most economical expenditure of power.

From these curves the engineer can calculate the number of units and size of each dynamo and engine, the method of operating them, whether by Corliss or high speed, by countershafting and belting or direct connection; he can determine the number and size of the boilers and pave the way for the compiling of a successful specification, on which subject I expect to say something in the next issue.

New York Electrical Society.

A very interesting program has been arranged for this season's meetings of the New York Electrical Society, and special efforts are being made to increase the society's usefullness. The society was organized in 1881, and its membership now numbers 350, and rapidly increasing. The aim of the organization was, "the advancement of electrical knowledge and the study of electrical and other scientific phenomena." In the program for this season, the regular course of lectures and papers has been supplemented with a series of visiting meetings, as they are called, at which practical illustrations of work in the leading branches of electrical application are seen. On the program of papers and meetings are noted the following:

Lecture on "Some Leading Phenomena and Principles of the Alternating Current," by Mr. C. S. Bradley.

Lecture on "The Production of the Higher Forms of Carbon (such as Carborundum, Diamonds, etc.,) by Electricity," by Mr. E. G. Acheson.

Visit to the Metropolitan Art Gallery and Museum, with a lecture on "Interior Lighting," by Mr. Luther Stieringer.

"Niagara on Tap: A Lecture on the Details of the Water-Power of Niagara," by Mr. T. C. Martin. The lecture will be illustrated by lantern slides made from photographs taken specially for the lecture.

Lecture on "The Doctrine of Unity in Electricity," by Dr. Michael I. Pupin.

Visit to an electric lighting station.

Talk on "Street-Railway Practice in the United States," by Mr. C. B. Fairchild. The lecture will be based on personal observation in a trip across the country and through the South, and profusely illustrated by lantern slides.

Lecture on the "Use of the Electric Light in Lantern Projections," by Mr. E. L. Hopkins. In this lecture the incandescent light and the arc light will be shown on the screen in varying conditions, and the voltmeter and the ammeter will also be visible, so that their readings can be followed with all the changes in the power of the light.

Lecture on "The Static Machine and Its Use and Office in Electrotheraphy," by Dr. W. J. Morton.

The requirements for admission to membership are very few and any person of good repute, who is connected with or interested in electrical work, is eligible for admission to the society. An application blank, which will be forwarded by the secretary on request, must be filled in with the name, address and occupation of the applicant, and returned. The name will be endorsed by a member and presented for election at the next meeting of the Society. The entrance fee is $1.00 and the yearly dues are $3.00.

In a circular recently issued by Mr. George H. Guy, the secretary, the members of the society are earnestly requested to take a more active part than ever in increasing the membership, and thereby the resources and usefulness of the organization. The officers are endeavoring to make it worthy of its proud position as the oldest electrical body in the country, and its mission of being a help to young electricians and an up-to date means for the general public of discussing and illustrating the most recent and interesting developments in electrical work.

Receiver for the Dubuque Light and Traction Co.

The first of this month an order was entered by the court appointing Mr. John Balch, of Chicago, receiver for the Dubuque Light and Traction Company, of Dubuque, Iowa. The petition for the receiver was made by The Old Colony Trust Company, of Boston, which holds a trust deed for $400,000. The history of the interests represented by this company is a series of ups and downs. The Dubuque Electric Railway Light and Power Company was incorporated in 1889, and was afterwards consolidated with the Eighth Street and West Dubuque Street Railway Company. The company collapsed in 1892, and at the foreclosure sale was purchased by the General Electric Company for its judgment of $60,000 and the amount for which the road was bonded, $240,000.

The First Electric Mining Railway.

The first electric railway built in Hungary was for use in a mine has been constructed by Ganz & Co., of Buda-Pesth. The generating plant was constructed at the mouth of the mine and furnished current at 320 volts. The power plant furnished current not only for the railway, but also for an electric hoist and a pump of about 1,000 gallons per hour capacity. The generator was driven by an engine of 40 horse-power. The plant will be greatly enlarged to operate machinery in other parts of the mine. The railway is about one and one-half miles in length. The locomotives used are of six horse-power and draw from 18 to 20 mine cars. The locomotive is three feet six inches wide by four feet eight inches high. The entire equipment is reported to be very satisfactorily managed and new uses are constantly being found for the current. A rock drill operated by electricity is one of the latest appliances introduced.

Some time ago the West End Railroad placed in service two special electric cars which were handsomely finished and equipped with every comfort. These cars have been run as private parties have engaged them. Their use has been almost continuous and the demand has been such as to warrant the purchase of more cars of this kind.

Electrical Industries.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

Advertising Rates upon application.

This number of Electrical Industries completes Volume V, or the fifth year of its publication. The success of the journal was assured from the start, having received a generous support from all classes of patrons. This has in a great measure been due to a rigid adherence to the lines marked out by its originators. The field has been clearly defined which it occupies and in this a great departure was made from the customs of the electrical press. All complicated, technical and purely scientific matter, such as would only be understood by those who have had the advantages of an extended education, has been excluded from its columns, and its pages devoted entirely to the interests of the practical readers. It has contained a record of current events in the industry, articles on practical subjects, illustrations of modern plants, equipments and apparatus, statistics, etc., and has endeavored to furnish full and reliable information on everything connected with the industry. In the preparation of the coming volume its editors and publishers have secured a large number of contributors from the most prominent writers on electrical and mechanical subjects, and have extended its sources of information. It will in this respect and in general excellence exceed all previous volumes. During the gradual recovery from the financial depression of last year, when expenses were curtailed and expenditures for advertising were cut down by all business houses, Electrical Industries was specially favored with a liberal patronage,and thanks are now extended for that generous support. The journal is being more generally appreciated by subscribers, as the returns from our offices and different agencies attest. Electrical Industries extends to its many readers holiday greetings and heartily wishes each and all a merry Christmas and a happy and more prosperous New Year.

Plans for a national association of manufacturers are being arranged and a call has been issued by the Manufacturers' Association of Cincinnati and Hamilton county for a meeting in the city of Cincinnati on January 22, 1895, to perfect the organization of an association. In the call addressed to the manufacturers of the United States the aim of the proposed association is briefly outlined. The association shall embrace among its purposes: "First—The advocacy of carefully considered legislation, to encourage manufacturing industries of all classes throughout the country. Second—The discussion of ways and means whereby trade relations between the United States and foreign countries may be developed and extended. Third—The establishment in South American capitals and other desirable points of permanent expositions for the display of American products. Fourth—Such other topics as may be agreed upon by the Convention." The invitation is extended not only to accredited delegates from organized exchanges and local organizations representing manufacturing interests but also to individual manufacturers. It is intended that the convention shall be non-political, non-partisan and non-sectional. Replies and suggestions are requested by the above committee. The movement is certainly commendable and should receive the support of all manufacturing interests. There are numerous associations representing specific industries but no national organization which seeks to advance the interests of manufacturers in general. The improvement and extension of the trade relations with Central and South America and the procurement of such legislative enactment as will further the interests of manufacturers, the improvement of transportation facilities and the encouragement of American steamship lines, come within the province of such an association. Manufacturers of electrical machines and apparatus whose products and manufacturing facilities are unexcelled can increase their export trade and extend the present foreign markets by aiding in the organization of such a national association. The discussion of ways and means by the representatives of the different manufacturing interests, will extend and increase the knowledge regarding the exportation of goods to the southern countries. Cincinnati is well located for such a convention and its business men should be commended and supported in their efforts to bring about the convention in January next.

The transmission of power by means of electricity has attracted general attention during recent months and has furnished grounds for speculation as to the distances it can be economically transmitted and the best methods for such transmission. The water falls and coal mines, as the store houses of energy, have been variously considered for the location of great generating plants. The large plants under construction in different parts of the United States and the projects for the erection of others at favorable points are but the carrying out of the same ideas that are manifest in Switzerland, Sweden, England and other European countries in similar enterprises. While the value of electricity in such fields should receive due attention, its value for the distribution of power should not be overlooked. Numerous plants have been installed in large manufacturing establishments which are demonstrating both its economy and superior advantages over previous methods. Although the systems show advancement in the present practice there is nothing that would lead us to think that the greatest perfection had been reached, but on the contrary we may look for considerable improvement in plants of this kind. The field will be extended and manufacturing works of other kinds than those that are now considered best adapted for the use of these systems of distribution will avail themselves of its advantages. Makers of tools and machines will adopt them so as to take advantage of the easy regulation of the electric motor and will construct them so that the motor will form a part, as is now the case with numerous lathes and grinding tools. The cost of installing an electric system of distributing could be saved in a few years in many manufacturing establishments which are using antiquated methods whose operation, care and maintenance demand considerable time of the superintendent and manager. The field in which electric power in used has constantly broadened and in this direction is one of its most useful applications.

The advantages of the electric system of power distribution are at once apparent to one who enters factories where the different systems are in use. Long lines of shafting with numerous loose and clutch pulleys, levers and bars, whirling belts causing a continuous rattle and jar, shaking the building and endangering the lives of the workmen, hold the attention of the visitor to works where the old methods are in use. A large percentage of the power of the works is consumed in the operation of this shafting and it is consumed for the entire time that the works are in operation. An increase or decrease in the amount of power required does not affect materially this constant tax on the generating plant. The actual power consumed in effective work is but a small part of that generated. In plants where the engines are located in different parts of the works and the steam distributed through pipes, the loss through condensation of steam and increased cost of engines and attendants at once places establishments so equipped at a disadvantage. The close competition of the present time demands of manufacturers the best and most economical methods of production. The more recently erected works in the construction and equipment of which modern ideas have been incorporated have a great advantage over those with old equipments and methods. The electric system of distribution demands but little attention in its operation. The power station is easily adjusted to the load of the factory. The loss of energy in transmission is less than by any other method. When power is not wanted on any set of machines the motor is quickly stopped and as easily started when again required. During such periods the generating plant is taxed only as a reserve. A comparison of several plants, some using electricity and others using mechanical methods of distribution, shows that but one pound of steam was required in the electric system to produce the same power at point of consumption that over two pounds with the mechanical methods. This shows not only the increased cost of operation but also the larger size of power plant required. The number of attendants would be greater and also cost of maintenance in the latter case.

THE lack of confidence on the part of the general public in railway corporations was well illustrated at a Chicago meeting held recently. The Chicago City Railway Company through its representatives met the residents of Indiana Ave., on which street there is now a horse car line. The company presented in an excellent manner its plans for substituting an electric line for the present horse line. A paper was presented in which was described the plans and by the use of stereopticon views the plan of construction was illustrated. An overhead trolley system was proposed, of a substantial but light construction, the feeders to be run underground and carried up inside the hollow iron poles. The question of safety of the overhead trolley system was called up and satisfactorily answered. The underground and storage battery systems were considered by the company impractical under the conditions that there existed. Many of the property owners gave their views on the question, some in favor and others against the proposition of the company; some demanded the repeal of the present ordinance and others would have no trolley line. The proposition of General Counsel Grinnell to discuss the question did not meet the views of the audience and brought out a flood of questions and a number of speakers. The assurance of the representatives of the company that it would deal fairly in meeting the wishes of the property owners would not be accepted by the audience, which after a somewhat stormy discussion adjourned.

Since power began to be used in industrial pursuits it has been the aim of many to discover an easily obtained form of power. Some working in one direction have sought to secure perpetual motion and others to transform according to their needs the various forces of natnre. This field has again been covered in the search for a source of power that would permit small electric lighting stations to be established wherever they were desired. The essential points in this power should be that it be easily obtained and such apparatus as was required should need but little attention. One of the oldest and most familiar forms of power was that afforded by the windmill, and this has been the subject of considerable experimenting. At first and especially to those who were not conversant with the electrical problems of the case, this seemed an easy means of providing the summer residence or isolated homes and shops with electric lighting plants. Electrical apparatus of all kinds having been greatly reduced in cost such a plant seemed within the reach of all. The incandescent lamp is most particular about the service it receives. A pressure of 40 volts or 60 volts is not what a 50 volt lamp demands but a constant pressure of 50 volts. The variable power therefore rendered by the windmill requires some method of regulation. The uncertainty of the wind demands a sufficient storage capacity. These two items have been the subject of numerous experiments and tests by well-known engineers on both sides of the Atlantic and while the results obtained electrically were sufficiently satisfactory the cost of the plant was out of proportion to the output of the station. The equipment is also complicated and the public is not sufficiently familiar with electrical apparatus to operate it without the occasional inspection by some one accustomed to the care of such plants. Improvements have been made in the dynamo which makes it practically self regulating and improvements will undoubtedly be made in other directions so that the entire equipment may be procured at a comparatively small cost and be of such a nature that it is practically self-operating.

Giving Election Returns by Telephone.

On election night the Chicago Telephone Co. inaugurated a new service which was in every way successful and which will no doubt be made a permanent feature hereafter. This was the giving of election returns to individual telephone subscribers by means of bulletins at short intervals.

The point from which the returns were carefully edited and then bulletined was at the main telephone exchange in the general manager's office. The news was received at this point from the city hall, the various political headquarters, and by long distance wires from such points as Milwaukee, Indianapolis and towns in Ohio, Pennsylvania, New Jersey and New York. Two special wires were reserved for this service between Chicago and New York, one being used to send the messages and the other to receive them. The toll stations within a radius of 50 miles around Chicago were supplied from this center. In the city of Chicago alone, however, some 1,500 subscribers received the returns in this manner, it being estimated that fully 20,000 people were thus served in the city and throughout the state of Illinois.

The service began about 7 P. M. and ended at midnight, 100 bulletins having been given in that time. In order to carry out everything on the scale planned it was necessary to employ 100 extra operators besides a large force of reporters and scouts to gather the news from the various headquarters and news centers. The returns as they came in were edited by General Manager A. S. Hibbard and Contracting Agent F. M. Buck and given to two experts who made 12 manifold copies. These copies were then given to the operators. New York and the intervening stations were grouped so that all received the same message simultaneously. In a similar manner the toll and other city stations were grouped and at these points experts made fresh manifold copies. The individual subscribers were bunched in groups of from 12 to 24. The original 12 copies were thus multiplied so that each group had a bulletin. The operator rang the bell of each subscriber in the group and then proceeded to read the bulletin in a clear voice, she having been instructed not to pay any attention to interruptions. In this way the service was well nigh perfect and the subscribers were more than pleased. It proved to be very popular, although of course, it was necessary to confine it to the residence subscribers and the principal hotels and clubs. In point of time it is claimed that the returns were given out much quicker than by telegraph and besides it had the advantage of reaching thousands simultaneously. It was the occasion of many social parties at the homes of subscribers who invited their friends to hear the returns. ELECTRICAL INDUSTRIES was especially favored in receiving the service.

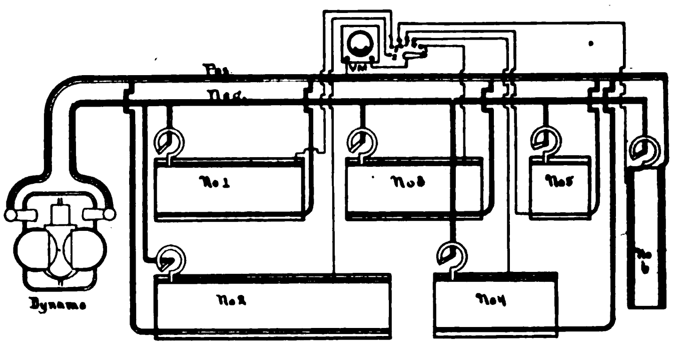
The company has received since the election a great number of compliments and acknowledgments of the work done and naturally is more than pleased with the result. It was, however, something of an experiment and the experience thus gained will enable it to give even better service in the future. The success of the undertaking was due entirely to the excellent plans laid out and executed by General Manager A. S. Hibbard and Contracting Agent F. M. Buck. Everything was carried out without a hitch and reflects great credit on these gentlemen. The experiment has fully demonstrated the possibilities of the telephone for distributing news simultaneously over a wide area.

Electro-Plating Plants.

BY H. G. BROWNELL.

The electro-plating field is one which has to an extraordinary extent been left unoccupied by electrical engineers. It is difficult to understand why electrical engineers have left this field so deserted as they have. It may be partially due to the fact that the majority of practical electro-platers scoff at the idea of the necessity of any knowledge other than their own entering into the construction of their plants. Many of them have some very peculiar ideas in regard to setting up and operating an electro-plating plant. One of these is that the cross section of the conductors has nothing whatever to do with their carrying capacity, and that the one thing necessary is to have a conductor with an extremely large surface. This will account for the presence of so much brass tubing about an electro-plating plant, and the conspicuous absence of copper conductors. It is not uncommon to find tanks conducted up to the dynamo by such exceedingly small conductors that from one-half to eight-tenths of the total pressure generated by the dynamo is lost in the connecting rods or wires. This causes a vast change of pressure on the tank rods between no load and full load and means either, that a full load of work requires a great amount of time, or else that a small load of work cannot be operated without ruining it by burning. We therefore find it a not uncommon thing to see large anode plates hung on the cathode rod beside a small job of work in order that the tank may be sufficiently loaded to drop the pressure below the "burning" point.

In order to do even and perfect plating and to do it as rapidly as possible, it is necessary that the pressure at the terminals of the tanks should be correct and constant. This is just as necessary as is a constant pressure on an incandescent lighting system, because if the pressure becomes at any time higher than it should be the deposit on the cathodal plate is rough, and in some metals is turned perfectly black, while other metals are deposited in a granular form. These granules rub off very easily and do not become a part of the solid deposit. This effect in the vernacular of electroplaters, is called "burning." If the pressure becomes too low for any reason, the work is not ordinarily spoiled, but the time required to produce a given deposit increases in proportion as the pressure is decreased below the proper amount. The only manner in which the plater can determine whether the process is going on satisfactorily or not is to lift the pieces of work out of the solution from time to time and examine them. He determines from this examination whether or not the plating is being carried on too rapidly, but nothing more. If he thinks the metal is being deposited too slowly, he slightly increases the pressure generated by the dynamo by whatever means have been there provided.



ELECTRO-PLATING PLANTS.

The only dynamo which platers have been able to purchase have been shunt wound machines, regulated either by a rheostat in the shunt circuit, or a series of plugs on the base of the machines, these being used for cutting in and out different coils in the field of the machine. Other machines are entirely unprovided with means of correcting the variations in pressure due to varying loads. It is customary to place a large rheostat in the tank circuit of such machines thus adjusting the pressure delivered to the tank. Some platers prefer to place this rheostat across the tank rods, thus enabling them to load the machine sufficiently to drop the pressure below the "burning" limit. Both of these methods are very wasteful but the latter is especially so because it not only consumes a large amount of energy but causes the machine to produce a heavier current than necessary, thus producing more sparking at the commutator and unnecessary heat.

The only indicator provided by most plating dynamo manufacturers is a little galvanometer placed in the outside circuit of the machine and which indicates simply the presence of a current, or in some cases, roughly, the strength of the current. No pressure indicator, however, is ordinarily provided.

There is no special reason why an electroplating plant should not be arranged with the same engineering skill which characterizes small isolated incandescent lighting plants. From an electrical stand point the generators have exactly the same office to fulfill, viz., that of producing a constant pressure at all current loads. In small isolated incandescent electric lighting plants shunt machines were abandoned years ago and compound wound machines put in their place. and yet the manufacturers of one of the best lighting dynamos built in this country are still placing on the market shut wound plating dynamos with field regulators and without a pressure indicator.

Some three years ago the writer was requested to design a line of plating dynamos which should, be equal, and, if possible, superior to any then on the market. It was realized that the undertaking was not an easy one, as it is a well-known fact among electrical engineers that dynamos generating exceedingly low pressures with correspondingly high currents are liable to reverse their polarity upon slight provocation, and are also in the habit of dropping their current under a heavy load, especially if the commutator surface does not remain bright. It is also very difficult to keep the brushes from sparking excessively and frequently difficult to prevent heating. The first step taken was to visit numerous plating establishments, to find the difficulties which were experienced. Many platers reported that their dynamos would unexpectedly stop generating, and would sometimes run for an hour or more doing absolutely no work. The next complaint was that of cutting and sparking at the commutator. Some machines required new commutators as often as every six weeks, and numerous brushes were being used. Careful measurements were made at plants that were said to be working properly at the time, of the electromotive force necessary for depositing various metals in their proper solutions, and also the number of amperes required per square foot of cathode. Using this data and information as a starter, a 450 ampere, 3 volt, compound wound machine was built. The iron used in the field magnet was ordinary gray cast iron. All trimmings and field terminals were made of cast copper. The commutators and brushes were also made of copper. The variation in pressure at a constant speed from no load to full load was about five per cent. Since then four different sizes of these machines have been placed on the market, varying in capacity from 225 to 2,400 amperes. They are all wound for a maximum pressure of four volts, but may be operated at any pressure below that, and above one-half volt. It has been discovered that with precisely the same windings different machines will vary from five per cent under compounded to five per cent over compounded. This variation is due, undoubtedly, to a difference in the quality of iron. The compound coil was placed on one field core only. Although these machines were compounded so very closely, it was thought best to furnish with each a pressure indicator in order that the operator might determine at any time without examining his work, the exact pressure at which his tanks were being operated.

It is a well known fact that different metals and solutions require different pressures. For example, to plate copper in an acid solution (a solution of blue vitriol to which a small quantity of sulphuric acid has been added) requires only three-fourths of a volt, whereas copper, plated in a cyanide of copper solution requires a pressure of from three to four volts. It is therefore obvious that in order to operate different solutions with the same dynamo, some arrangement must be provided for keeping the proper electromotive force at each tank. This has ordinarily been done by means of rheostats in the tank circuits, which is of course very proper as far as it goes, but the plater is usually left with absolutely no means of knowing when his rheostat is so adjusted as to give him the proper pressure.

The plating plant of a large factory was recently overhauled and put into proper working shape with one of the above-mentioned dynamos as a source of current. The dynamo was speeded so as to produce an electromotive force of three and one-half volts. Two bus-rods of three-fourths inch round copper wire connecting directly with the machine were mounted on insulators on one side of the tank room. From these rods, smaller rods, varying in size with the capacity of the tanks they were to feed, were carried to the various tanks across the ceiling of the room. The tank-rod which was joined to the negative bus-rod was in each case connected with the center of the rheostat. The other rod was connected directly with the anode-rod of the tank, and the end of the rheostat with the cathode-rod. The pressure indicator was placed on the wall where it could readily be seen from any one of the five or six tanks. One binding post of the pressure indicator was connected to the positive bus-rod, while the other was connected with the lever of a six point switch. From each of these points pressure wires were run to the tank side of the rheostats. The operator was therefore enabled to determine at any time exactly what pressure the tank was receiving. When No. 1. tank was to be unloaded, its rheostat was thrown to the zero point, or in other words, the current was taken off from the tank. The tank could then be unloaded at leisure, without risk of burning the work which was left until the last. A new load was then placed in the tank, the volt-meter switch thrown to the point in connection with that tank and the rheostat gradually cut out until the indicator showed a pressure at which the tank should be operated. The operator could then leave the tank, resting assured that the metal would be deposited as rapidly as was consistent, and that it would not be deposited too rapidly. The brushes in this machine were not set oftener than once in six weeks or two months and the commutator did not require turning for nearly two years, at which time its diameter was reduced about a sixteenth of an inch. The electromotive force remains practically constant excepting such variations as were due to slight changes in speed.

It is safe to say that this is the best arranged plant in Chicago. There are several electrotyping plants, using these same generators, which are correspondingly well arranged but are less complicated. Two acid copper tanks are operated in series, each taking a pressure of three-quarter volts. The pressure indicator is connected across the terminals of the machine, which is speeded to generate an electromotive force of one and one-half volts. The tank operator must keep equal areas of cathode surface in the two tanks, but otherwise the plant takes care of itself.

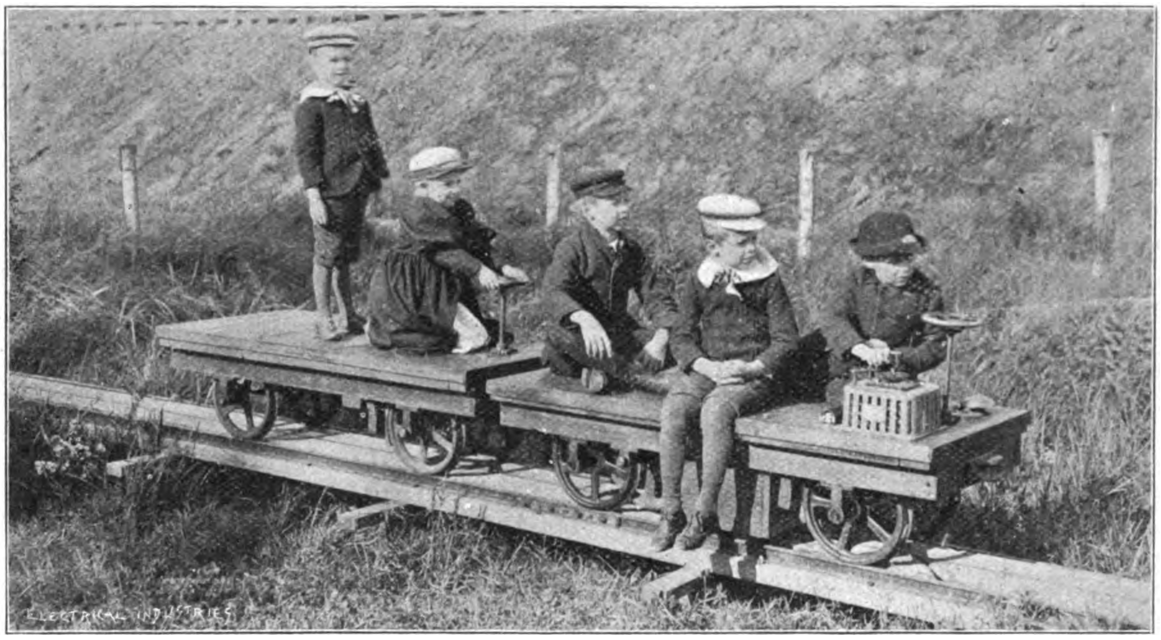
The electro-plating field is growing very rapidly and opportunity for improvement in this particular branch is unlimited. There are in Chicago outside of refineries quite a number of concerns using currents ranging from 1,000 to 3,000 amperes, and very few of them are as well arranged as were the first experimental incandescent lighting plants.

Telephone and telegraph lines were considerably damaged by the severe storm that passed over New England the first part of last month. The loss will be heavy.

A Novel Electric Railway.

There has been in operation for a short time between Pithiviers, a station on the Orleans & Malesherbes railway, and Toury, a station on the Orleans & Paris railway, France, a small steam railway which has excited a good deal of interest. This road has a guage of but 24 inches and is laid with 19 pound rails and steel ties. The road was constructed to assist in marketing the produce of that region and also to carry passengers. In 1893 the road carried nearly 30,000 passengers. It runs along the side of the highways. The engines and cars are of a size in proportion to that of the track.

While popular interest, as well as that of engineers, has been drawn to this road on account of its small size, it is, however, a giant in comparison with an electric railway which has been in operation for some time at Dellwood, Minn., a summer resort on the beautiful lakes lying about 15 miles north of St. Paul. A view of a train on this road with operating force and passengers is shown in the accompanying engraving. The road was built by Mr. A. M. P. Cowley, a banker of St. Paul, for the amusement of his son, a boy of seven or eight years.



A NOVEL ELECTRIC RAILWAY.

The road is about 600 feet long and runs from the railway station to the cottage. The rolling stock consists of two trailers and a motor car. The gauge is but 14 inches, and the rails and cars are of corresponding size and construction. The cars are 60 by 24 inches in size. The rails are of the T pattern laid on 2 by 4 inch ties. The third-rail system is in use, the third rail being placed between the two rails of the track. The track rails are used as the return and are bonded with copper wire.

The power house at one terminus of the road supplies the incandescent lights in the house as well as the road with power. Power is furnished by a two horse-power Shipman petroleum engine, belted to a Perret generator of a like capacity. Thus the output of the station is about 15 amperes at 110 volts. The engine, which runs at a speed of about 375 revolutions, is entirely automatic in its action and therefore requires little attention. The dynamo thus operated needs little care, and the operating force of the road is reduced to the minimum. The station instruments, which are mounted on a neat switchboard, include everything needed in an electric station. Volt and ampere meters, lightning arrester, fuse blocks and switches, are among the instruments and devices on the board.

The road has a suitable car barn for the cars when not in operation, accommodating the equipment of the road. The line has no curves and but two grades, one of 16 and one of 10 per cent. The motor car is equipped with a one horse-power motor, which is sufficient to pull a loaded train up these grades. The motor is geared by double-reduction gears to axle of car. The starting rheostat is conveniently placed at one end of car. Each car is equipped with brakes.

This electric railway furnishes an interesting occupation to Master Archie Cowley, the manager and his young playmates. Although the road does a continuous business during the summer it is not operated under a municipal franchise nor by virtue of a charter from the state. Its train schedule, while not advertised in advance, conforms better with the ideas of its youthful passengers.

It carries passengers, freight and baggage from the railroad station to the terminus at the power station. Its business is done without reference to the rules of passenger associations and is not interfered with by the Interstate Commerce Commission. The little manager, although practically unrestricted in his action, furnishes a most enjoyable service to the patrons of the road.

This electric railway is undoubtedly the smallest in operation. It is an interesting, amusing and profitable application of electricity. It furnishes not only an instructive and amusing occupation to the children, but also a source of interest and pleasure to the adults.

Among the accidents of railways reported during the last month is one at Omaha, where a car became unmanageable on the Twentieth St. grade, and, after rushing uncontrolled a couple of blocks, jumped the track and collided with a convenient telegraph pole. The motorman was considerably injured, but the five passengers of the car escaped with slight injuries. A car on the Cicero & Proviso road, Chicago, collided with a lumber wagon, and the driver was killed and his companion seriously hurt. It was very dark, and the motorman says he did not see the wagon until too late.

Public Lighting in St. Louis.

The public lighting of the city of St. Louis is done by the various local electric, gas and other lighting companies, the city owning no plants. Contracts are made annually with the different corporations for lighting in a specified manner the districts into which the city, for convenience, is divided. The city lighting department is one of the departments under the board of public improvements and is in direct charge of a supervisor of city lighting, at the present time Mr. A. J. O'Rielly.

This department is furnished an office and a sufficient corp of assistants and inspectors to see that the lighting is properly done and that the city receives a proper return for the money expended. The working force of this department is made up as follows: One clerk and one assistant, five inspectors, two night inspectors and two inspectors of the second class and one draughtsman, making twelve persons besides the supervisor. The streets and alleys are lighted with electric lights, both arc and incandescent, gas and gasoline. The kind of light and hours of burning varies in different parts of the city. South of Keokuk St. the lighting is exclusively by gas or gasoline lamps. There are in the street lighting service 937 gas lamps and 169 gasoline lamps, lighting 30½ miles of streets. The gasoline lamps are reported as very unsatisfactory.

The gas and gasoline lamps are burned six or seven hours each night while the electric lights burn all night. Testing the quality of the gas and the light given by the gas lamps forms part of the work of this department. For doing this work the department is equipped with a full set of apparatus. Gas is also used for lighting the public buildings and also for heating purposes in the fire, police and health departments, the bills for the latter being verified by this department.

The larger part of the city is lighted by electric lights, in which service there are 2,029 arc lamps and 2,470 incandescent lamps. Of this number of arc lamps, 1,930 are on streets and alleys and the balance on boulevards and in parks; 1,720 incandescent lights are placed on streets and 690 in alleys. Four hundred and sixty miles of streets are lighted by electric lights and 95 miles of alleys. Except in the parks the electric lights burn all night. In lighting the public buildings there in use 63 arc lamps and 3,652 incandescent lamps. The prices paid for lighting are as follows: Contract with the Edison Ill. Company for 2,000 candle-power arc lights burning all night, $74.95 per year; in parks, sunset to midnight from May 1st to October 31st, $39.90; contract with the Laclede Gas Light Co., incandescent lights, 30 candle-power in alleys all night, $17.50 per year; same in parks to midnight, May to November, $3.37; 16 candle-power in buildings available at any time, $20 per year; same to midnight, per lamp per year, $6.02; Missouri Electric Light & Power Co., contract for 30 candle-power all night per year, $26; same in parks to midnight, May to November, $20; 16 candle-power in buildings available at any time, per lamp per year, $9.50; same to midnight, $7 per year. The prices for gas run uniformly at $1.18¾ per thousand feet. For 14 candle-power street lamps, moonlight schedule, per lamp per year, $37; while for the gasoline lamps, the price per lamp per year, moonlight schedule, is $27.96.

At the beginning of each year an estimate is made of the expenses of this department for that year and that amount, or such an amount as the city council sees fit, is appropriated for this department. The estimate for this year 1894-5 is $387,000. The expenses of maintaining the office of the supervisor of city lighting for the last year amount to $16,789.93, of which $13,941.13 was for salaries. The work of this department is not confined to the public lighting entirely but investigates all applications for the erection of poles and the construction of lines for the transmission of electricity for lighting and power, and also the lines of the telegraph and telephone companies, complaints relating to poles, wires, etc. Representatives of the department responded to 265 alarms of fire during the year. The department has also investigated accidents, electrolysis and abandoned wires.

Gas Light.—For gas for public street lamps, lighting, extinguishing, cleaning and repairing and removing lamps in the Carondelet Company's district, thirty-two thousand two hundred dollars.

Streets, amount expended		$32,007 21
Carondelet Gas Light Co., received	$32,007 21	

Gasoline Lamps, Maintaining.—For maintaining and removing lamps, five thousand fifty dollars.

Streets, amount expended		$4,669 81
Ohio Valley Street Lighting Co., received	$4,669 81	

Electric Lighting.—For lighting streets, boulevards, parks and alleys, two hundred twenty-five thousand dollars.

Streets, amount expended		$145,173 54
Boulevards, amount expended		7,370 90
Parks, amount expended		5,482 81
Alleys, amount expended		34,184 90
		$192,212 15
Municipal Electric Lighting & Power Co., received	$102,879 53	
Edison Illuminating Co., received	39,956 67	
Missouri Electric Light & Power Co., received	28,049 01	
Laclede Gas Light Co., Electrical Department, received	21,326 94	
	$192,212 15	

For lighting public buildings, forty-nine thousand five hundred dollars.

	Electric.	Gas.	Total.
Court House	$5,867 61		$5,867 61
City Hall	5,190 47		5,190 47
Four Courts	2,381 73	$0 12	2,381 85
Jail	593 26		593 26
Police Department, Four Courts	1,282 98		1,282 98
Police Stations	4,088 42	193 55	4,281 97
City Hospital	3,365 72		3,365 72
Insane Asylum	3,371 56		3,371 56
Female Hospital	2,021 64		2,021 64
Poor House	2,638 70		2,638 70
Morgue	189 47	15 35	204 82
Fire Department	7,456 28	169 55	7,625 83
New City Hall	57 88		57 88
City Building, 2322 Clark avenue	186 04		186 04
Public buildings in Forest Park	108 19		108 19
Water Department, south	21 40		21 40
Fire Alarm Office, Court House	376 76		376 76
Water Works	1,849 41	236 95	2,086 36
Union Market	1,056 82	801 13	1,857 95
Soulard Market		66 41	66 41
Health Department		114 64	114 64
Harbor and Wharf Department		23 81	23 81
Police Court, Second District		2 28	2 28
House of Refuge		1,844 13	1,844 13
Workhouse		507 06	507 06
Carondelet Market		16 20	16 20
Totals	$42,099 34	$3,990 68	$46,090 02

Municipal Electric Lighting & Power Co., received	$ 2,268 79
Edison Illuminating Co., received	870 01
Missouri Electric Light & Power Co., received	30,991 06
Laclede Gas Light Co., Electrical Dept., received	7,969 48
Carondelet Gas Light Co., received	2,709 17
Laclede Gas Light Co., Gas Department, received	1,281 51
	$46,090 02

RECAPITULATION.

	Appropriation.	Expense.	Balance.
Gas Light	$32,200 00	$32,007 21	$192 79
Gasoline Lamps, maintaining	5,050 00	4,669 81	380 19
Electric Light	225,000 00	192,212 15	32,787 85
Salaries	14,500 00	13,941 13	558 87
Expense	3,000 00	2,848 80	151 20
Lighting Public Buildings	49,500 00	46,090 02	3,409 98
Total	$329,250 00	$291,769 12	$37,480 88

Comparative statement of the cost of lighting for past five years:

PUBLIC STREETS, BOULEVARDS, PARKS AND ALLEYS.

Fiscal year ending April 7, 1890	$318,048 61
" " " " 13, 1891	211,130 44
" " " " 11, 1892	218,526 22
" " " " 10, 1893	228,499 93
" " " " 9, 1894	245,679 10

PUBLIC BUILDINGS.

Fiscal year ending April 7, 1890	$36,872 62
" " " " 13, 1891	39,719 69
" " " " 11, 1892	42,240 28
" " " " 10, 1893	43,739 27
" " " " 9, 1894	46,090 02

An itemized statement of the cost of public lighting is given above, showing the amount paid each company and cost of lighting each building.

The work of this department seems to be well arranged and very satisfactory service is secured the city. The money expended by the city for lighting is much less for the same service than paid by many other cities. The rates for electric lighting are much smaller than in the majority of cities and much below the cost to the larger cities owning their own plants.

A New Double Voltage Dynamo.

In the accompanyiny cut is shown the Fuller double voltage dynamo, manufactured by the Fontaine Crossing and Electrical Co., of Detroit, Mich. It combines features in its make up which will be generally appreciated by a large class of customers. The superior advantages of the double voltage dynamo have not been fully recognized heretofore, as their importance demands, partly because of the many other directions in which manufacturers have been working and partly from the lack of a well-designed machine. Now that the subject has been taken hold of and the excellently designed machine here shown has been placed on the market, the demand for such dynamos will steadily increase.

One of the disadvantages of the three wire system for small lighting plants has been that it required two dynamos, but this is now remedied by this machine, which can be most economically operated, furnishing current from the two sets of terminals for the two sides of the system. It can be installed in place of two machines without any change in the wiring. It can also be used on the two wire system for either voltage. In many manufacturing establishments or in large buildings where power is required, it is exceedingly difficult to furnish all departments with just the power required. The lights demand a uniform voltage, the motors some at a great distance require a higher voltage for economy, others a lower, and to furnish each service as it is demanded requires several ordinary dynamos. The double current furnished by this machine, however, gives the lamps 110 volts, and for power purposes current at 220.

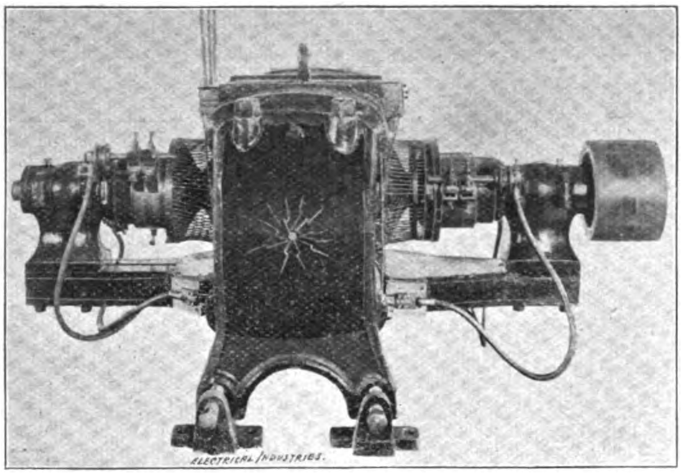


FIG. 1—A NEW DOUBLE VOLTAGE DYNAMO.

Manufacturing establishments, foundries, machine shops and the many other industries where power is used this double voltage dynamo will be found most valuable as it will furnish current at a considerable distance on smaller wire and will also furnish current for lighting at a desired voltage. Electric cranes, drills, elevators and machines tools of all kinds are thus furnished with current from the same dynamo as the lights.

Perhaps at the first glance the advantage of one dynamo over two is not apparent, but the first cost and cost of operation and maintenance amounts to a considerable sum. The space occupied, the cost of machine, foundation and extra equipment to transmit power from engine to dynamo, the care and repair, are items that appear in the account with the two dynamos that are not met with the double voltage dynamo as here shown. Either 110 or 220-volt current, or both, may be taken from this dynamo.

The design and general construction of dynamo is shown in the accompanying cut. All parts are well ventilated. The bearings are long and large, equipped with latest methods of lubricating and the general construction is such as will secure a long life. The windings of the armature and field coils have been carefully made, well insulated and protected. The company guarantees each machine, both mechanically and electrically.

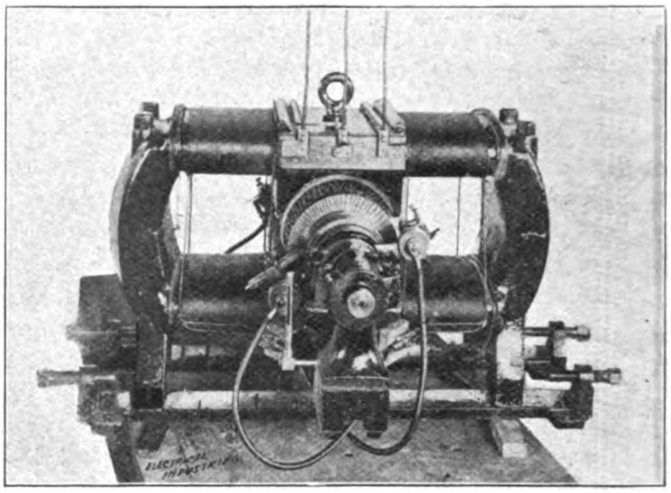


FIG. 2.—A NEW DOUBLE VOLTAGE DYNAMO.

The company has every facility for the production of electrical apparatus, and its engineers are well known to the trade through the apparatus which they have designed.

Experiments on the Heating Power of the Electric Light.

Mascart found that an electric glow lamp, 32 candles, set fire to cotton wool saturated with indiarubber, and packed around it, in two minutes; to black silk in six minutes; and to a double layer of cotton cloth in two minutes. The same materials not saturated with indiarubber did not take fire. Captain Exler, of the Austrian army, now finds that a 16-candle lamp, sunk in paraffine, reaches a maximum temperature of 94 deg. C.; one of 25 candles 101 deg. C. A layer of gunpowder, ecracite, or pulverulent pyroxoyline is not set on fire by this; the ecracite melted and the gunpowder lost all its sulphur. If the material be spread on a material —eg., wood—which is opaque to heat rays, the action is more marked, when the lamp is brought very near to it; the ecrasite melts, the pyroxyline darkens, the gunpowder loses its sulphur, and the nitre melts, and the wood chars. Two lamps in a cavity of wood get up a temperature of 215 deg. C., a charining temperature; but the explosives did not go off, though they decomposed. When the cavity was filled with water it boiled in fifteen minutes. The spark produced on turning off the flame only kindles these explosives when they have become very dry; but the spark produced on switching off a feeble resistance between two lamp wires can do so readily. If the lamp breaks, pyroxyline or gunpowder does not ignite, but an explosive gaseous mixture will; whence, in dangerous surroundings, the lamp wall should be thick, and the lamp should never be brought too near combustible material.—The Gas World.

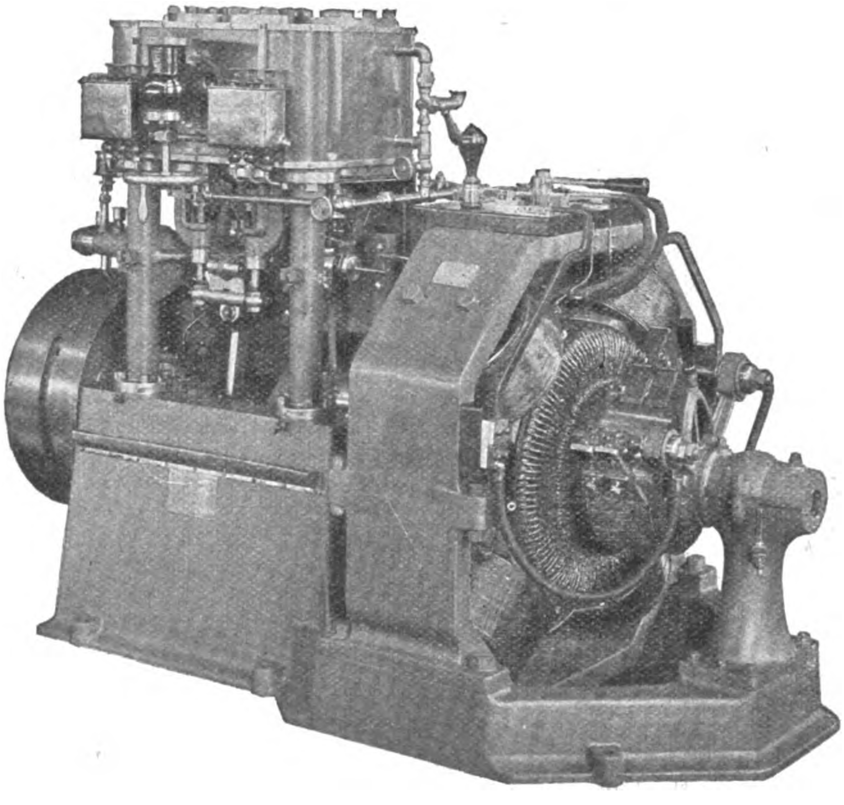
Electricity on Shipboard: Its Present Position and Future Development.*

BY S. DANA GREENE, LATE ENSIGN U. S. NAVY.

On shipboard electricity has at last been recognized as the proper agency for lighting, and apparatus and methods of installation have been so improved and standardized that the electric ship plant can now be relied upon for continuous and economical service. Beyond this, it cannot be said that electricity has been introduced to any considerable extent in marine installations, although the future gives promise of many new applications. Inasmuch, however, as practically all other applications aboard ship are dependent upon the lighting plant, it is natural that the best engineering skill has been occupied in perfecting the latter. As a result there have been developed for marine work a special type of generating set (engine and dynamo), special appliances (switches, junction boxes, cut-outs, stuffing tubes, water-tight globes and lanterns, etc.), special insulation for conductors, special methods of wiring, special forms of search lights, and special men who may properly be called "Marine Electricians." These apparatus and appliances differ materially from those in use on shore, and must be used under service conditions entirely dissimilar. Salt water, salt air, steam and the excessive heat of ship boiler and engine rooms, would play havoc in a very short time with the best modern shore installation, as they have, in fact, with many of the early ship plants, and if there is any place in the engineering world where the old axiom of "Penny wise and pound foolish" should be stamped in large letters, it is on the plans of an electric marine plant. Such an installation is expensive when compared with similar work on shore, the first cost being perhaps 100 per cent or more greater. Inferior material and workmanship are sometimes employed on shore, and fair results obtained by careful supervision and management of the plant. Such a policy is unwise under any circumstances, but aboard ship it is fatal; depreciation at once becomes heavy and rapid, and the marine plant has no manufacture or repair shop close at hand to repair damages or supply new material, nor are there always skilled electricians aboard ship to locate the cause of troubles and apply the remedy promptly.

It is wise for the naval architect in designing and installing a marine electric plant, whether it is for a man-of-war, merchantman, or yacht, to see that the material is ordered from manufacturers who have made a specialty of marine apparatus and to have it installed by practical marine electricians, who beside knowing something about electricity, know what a ship is and what the conditions are at sea. Finally, the plant should be put in charge of good, practical, dynamo-tenders, by which is meant men who are familiar with both steam and electrical machinery and their fittings. The best practice in electric installations is to be found in the various navies of the world, where specifications are always more rigid and work is better done (at greater expense of course) and more closely inspected. It is gratifying to know that in establishing and maintaining the high standards of excellence which have characterized the vessels of our new navy, and which have given these vessels an international reputation, the electric plants have kept pace with the other parts of the construction and equipment and they are today the finest examples of marine installations afloat. In an able article on "Naval Dynamo Machinery," recently published in the proceedings of the U. S. Naval Intitute, Lieutenant J. B. Murdock summarizes his experience of many years' study and practice, coupled with an extensive personal inspection of the best European naval installations, by saying that "our electrical plants are in most respects superior to those in use in other navies, but deteriorate more rapidly." This deterioration has been due in the past, partly to the fact that strength and durability have been sacrificed to some extent (as admitted by Lieutenant Murdock) to secure the greatest compactness and least weight, and partly to the fact that the navy has had to create and develop a class of men competent to operate ship plants and to keep them in repair. The first difficulty has been remedied in the latest designs of apparatus now being furnished the navy, and the latter difficulty is gradually remedying itself through the school of practical experience; so that the deterioration in the future will undoubtedly be much less than it has been in the past.

On war vessels the plant is properly considered as one of the vitals of the ship, and is always located below the protective deck, in a compartment by itself, near the boilers and as near the center of the ship as possible. These comportments require artificial ventilation, and even then are often uncomfortably hot (aboard the "San Francisco," for example, the temparature ranges from 120° F. up.) In some of the larger war vessels abroad there are two plants, located in different parts of the ship, one for ordinary service (above the protective deck) and the other for service in action (below the protective deck). The practice of dividing the plant, however, is more expensive in first cost, as well as in operation and deterioration, and is bad on general principles; it has never been adopted in our service.



A STANDARD DIRECT CONNECTED SET FOR SHIPBOARD.

Engine and dynamo should always be direct coupled (i.e., the armature shaft of the dynamo should be directly connected to the engine shaft). Belts take up room, are liable to stretch and slip (from the rolling or heeling of the vessel, or from oil) and reduce the efficiency of the plant from 5 per cent to 15 per cent, depending upon local conditions. The best practice is to provide a fixed coupling, readily accessible, between dynamo and engine. A reserve capacity should always be provided, if space allows. In the navy, the present practice seems to provide a reserve of from 25 per cent to $33\frac{1}{3}$ per cent of the full load duty of the plant, a separate unit furnishing the reserve. Thus, the full load service of the "New York" requires about 85 horse-power dynamo capacity which is supplied by two units, while a third, of 21 horse-power, furnishes the reserve.

Engines should be of the open type, compact and strong, with rigid frames, large bearing surfaces and liberal clearance in the cylinders. Vertical engines occupy much less desk space than horizontal and are better adapted for ship service. With the present size of marine plants, the consumption of steam is so small, as compared with the total amount used for other purposes, that it has not been thought necessary or advisable to complicate the plant by introducing compound engines; but as the uses of electricity increase in number and variety (thus necessitating larger generating plants) it will probably be found economical to introduce the compound type. It is frequently used abroad at the present time. The multipolar type of dynamo should be used, since it permits of slow armature speed, less weight, greater compactness and closed magnetic circuit. With the four pole type, only two brushes are necessary, and this is a distinct advantage.

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*Abstract of paper read before the Society of Naval Architects and Marine Engineers, New York, Nov. 15, 1894

Dynamos should be compound wound (insuring automatic regulation of the electro-motive force with change of load) and should be provided with a field rheostat to compensate for the change in the resistance of the field winding, when hot or cold. Armature and field should be most carefully insulated, and the insulation resistance of both should be carefully tested before the plant is accepted; it should not be less than one megohm.

The wiring of vessels is the most difficult and expensive, as well as the most important part of the installation. With the wiring installed many of the circuits are very inaccessible, and should a fault occur it is difficult to locate and still more difficult and expensive to remedy. It is imperative, therefore, that only the very best material and skilled labor obtainable should be employed. Probably the best example of the highest grade wiring to be found is in our own naval vessels, and the specifications of the navy department are very rigid and complete. In Europe, and especially in England, it was the practice for several years to use what is known as the "Single Conductor System" of wiring, where one conductor only is run from the dynamo to the lamps, the hull of the vessel being utilized as the return conductor. The practice, however, has never found favor in this country, and it has a number of serious faults, with the single argument of cheapness in its favor. Recent practice abroad, evidently based upon unfavorable experience, does not favor it, and the system generally used is the two-conductor, insulated metallic return system. In England experiments have recently been made with a concentric cable, where one conductor is placed concentrically outside and insulated from the other, in one cable. Such a cable has the advantage of materially reducing the labor of wiring a ship, while still retaining the advantages of a completely insulated, metallic circuit; but it is not wise, in the writer's opinion, to abandon our standard two-wire separate conductor system, until the success of the new method has been thoroughly demonstrated by several years' test at sea. The wiring should be divided in separate circuits, lights which are located in the same parts of the ship and which are ordinarily used at the same time, being grouped on the same circuit.

The present standard navy wire has no lead covering. It was formerly required as a mechanical protection and water-proof covering of the wire, but it was found that in handling the wire aboard ship, the lead covering was very apt to become broken, thus allowing water to soak in between the covering and the wire and the ragged, broken edges were frequently driven into the insulation of the wire to such an extent as to "ground" the metallic conductor to the hull of the vessel. Furthermore, it was practically impossible to discover defects in the insulation of the wire under the lead covering, before the wire was put in place and these defects often caused trouble later in service. The writer advocated the abandonment of the lead covering in 1887, after a year's experience with it on board the cruiser "Atlanta," where many of the circuits had to be entirely replaced during that period. The insulation of the wire should be depended upon to prevent troubles (the best rubber covered wire only being used) and a good heavy braiding affords all the mechanical protection needed, beside the moulding. Samples of all wire should be subjected to rigid electrical and physical tests before use. If a new ship is to be wired, the work should be done while the vessel is building, and the writer believes that the circuits for the engine and firerooms, the coal bunkers, and for the exposed decks should be run in continuous iron tubes, having water tight joints and an inner lining of insulating material.

The use of the electric motor is probably the most important development to be looked for aboard ship. On shore, where millions of dollars are now invested in single central station plants, the constant endeavor of the management is to make this investment more productive by keeping the machinery in opertation with a paying load for as many hours out of the twenty-four as possible. During the day, the percentage of lights in use is very small and current is therefore sold for power purposes, thousands of horse-power being thus connected in small units to the lighting circuits of the station. The advantages of the electric motor are now too well known to need repitition and with the improvement that has been made during the past two years in their durability and adaptability for special applications, there are many places aboard ship where they can replace the auxiliary steam engines, with a saving of expense in first cost and operation and in space and weight.

Search lights have been in use on war vessels as a military weapon of offense and defense for several years, but their use as an aid to navigation is recent. Vessels now passing through the Suez Canal use their search lights and so make as rapid progress at night as in the day time. Vessels now plying between New York and Savannah use their search lights in running up the Savannah river at night, and frequently save twelve hours' time from dock to dock in so doing. The Sound steamers throw the beam of their lights overhead in a fog, and the location of the vessel is indicated by a well defined luminous spot in a fog. The search light is frequently used for coaling ship or making repairs at night. These examples sufficiently indicate the uses to which an intelligent captain can put his search light. The general appearance, construction and operation of search lights has been greatly improved of late.

An instrument which will indicate quickly and with reasonable accuracy, the distance of objects within the range of vision at sea, is obviously of great advantage, both on account of its military value to a war vessel and as an aid to navigation in coasting and in making land. Several range finders have been devised both here and abroad, but by far the most complete apparatus is that invented by Lieutenant Bradley A. Fiske, U. S. Navy.

This beautiful instrument, after tests extending over a period of five years, has just been officially approved and adopted by the Navy Department, and it has been adopted by several foreign governments as well. The following extracts from an official report of the commanding officer of the "San Francisco" show what it will do in actual service;

"In January last, when at Pernambuco, Brazil, I sent to the department a tabulated record of the errors of the Range Finder as determined in the various parts where the true distances could be gotten from the charts. The average error of all the observations was about six-tenths of one per cent per thousand yards. Since that time I have always made use of the Range Finder at target practice, and in going into and out of port and in coasting. The Range Finder is thoroughly adapted to ship use, as is shown by the fact that its whole care and service are in the hands of three apprentice boys. These boys keep it in order, and go to it as their station at general quarters, getting under way and anchoring, and whenever the word is passed, "Man the Range Finder."

The Range Finders keep in order with almost no care whatever. There is a transmitter in the conning tower—one reading instrument in the starboard gangway—another reading instrument on the poop. The quiet and orderliness of target practice would be much increased if two reading instruments were added – one for the port gangway and one for the forecastle."

For night signals, the navy has recently adopted an improved form of the Ardois system, suggested by Lieut. A. P. Niblack, U. S. Navy. Four double lanterns, each lantern being colored half red and half white, are strung on a jackstay at the mizzenmast, the interval between the lanterns being 12 feet. An incandescent lamp is placed in each half of each lantern and connected by cable to a signal stand (see cut) mounted on deck as desired. Various combinations of red and white lights are then flashed by a suitable switch at the signal stand and the lights are burned until the signal is reproduced on all the answering ships. Another switch is used to "blink" the upper light, thus indicating some special code signal. This system is rapid and very satisfactory up to distances of three to five miles. For "wig-wag" signalling, between two vessels, a very neat, double, masthead lantern has been developed, the red and white lights being flashed in succession by a suitable key. A "multiple fibre" incandescent lamp has been recently brought out in England for use with these masthead lanterns, the individual fibres, or filaments, being so fine that they lose their incandescence immediately the current is cut off. With the usual single filament lamp, there is an afterglow, when the circuit is opened, which is sometimes confusing in rapid signalling· The search light provides an excellent means of long distance signalling, the beam of light being thrown overhead and waved to right or left. It has been reported that English war vessels have communicated successfully in this way, in Chinese waters, when more than fifty miles apart.

Electric firing circuits for firing the guns and torpedoes of war vessels will undoubtedly be used in the future; these circuits are so arranged that indicators at each gun and in the conning tower show when the gun is laid and ready for firing. The act of firing can then be performed by the pressing of a button in the hands of the gun captain or of the commanding officer, as may be desired. Such an arrangement will be appreciated for broadside or combination firing at close quarters.

Rapid communication, or exchange of orders, between distant parts of a large vessel is quite a problem. Verbal commands will not carry and the person to be communicated with is usually out of sight. Electric gongs and bells are useful as calls, and speaking tubes are largely used. On the "New York" there is a speaking tube "exchange" below the protective deck and under the conning tower. Some twenty or thirty tubes converge at this point and connection is made between their ends by a short length of flexible tube, so that the commanding officers by calling the "exchange" operatorcan have his single tube connected with any other tube and vice versa. This system is crude, however, and the operator must be sorely perplexed when a number of calls are "blown in" at once. There is no way of distinguishing where the calls come from, unless the operator has s sufficiently musical ear to detect a difference in the notes of the tube whistles.

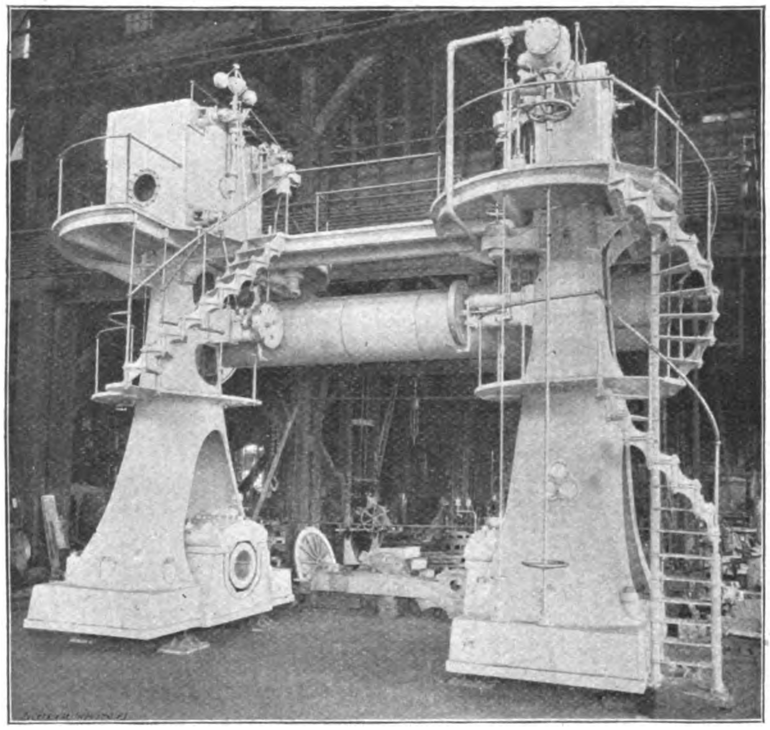
A far better system would be to have a direct telephonic connection between the Conning Tower and such other points as are desired, without any "exchange" at all. Such systems are now installed in many large office buildings and industrial establishments and give great satisfaction. Telephones have been tested aboard ship and found to be entirely reliable and an order can be given clearly by telephone that could not be under stood at all through a speaking tube, especially when there is much noise or confusion at either or both ends of the line.

The Eighteenth Convention of the National Electric Light Association.

The eighteenth convention of the National Electric Light Association is to be held at Cleveland, Ohio, February 19, 20 and 21, 1895. Arrangements are already made for the meetings at the Army and Navy Hall, and the Hollenden Hotel has been selected as the headquarters of the association while in Cleveland. The executive committee is at work on the program of the convention. The officers of the association and the members of the executive committee are men who have always taken an active part in previous conventions, and from this fact the next convention may be looked forward to as even more interesting than previous conventions. The city of Cleveland is most favorably located for a large attendance, and the comfort of members will be well looked after by the hospitable members of the fraternity in that city.

Allis Engines for the Metropolitan Elevated Railway's Electric Power Station.

In the accompanying cut is shown one of the engines just completed at the works of the Edward P. Allis Company at Milwaukee, Wis., for the electric power station of the Metropolitan Elevated Railway, Chicago. It will undoubtedly interest our readers as it is one of the first pieces of apparatus to be completed for this new and modern power station. The engine shown is one of four pairs of engines now being built by the Allis company for this road. Two pairs have cylinders 23 and 46 by 48 inches and the other two 36 and 72 by 48 inches. The generators will be directly connected on main shaft of engines.



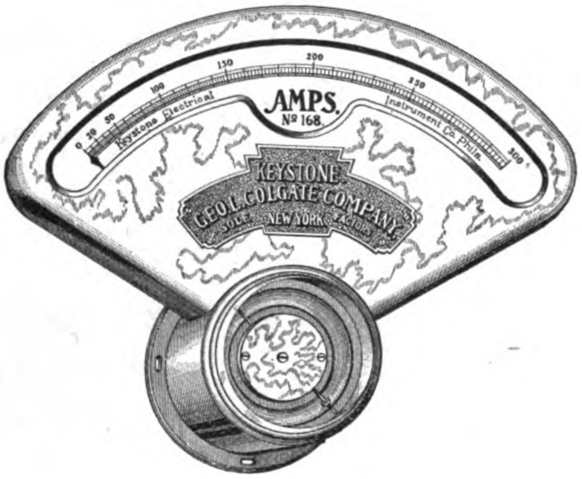
ALLIS ENGINES FOR THE METROPOLITAN ELEVATED RAILWAY'S ELECTRIC POWER STATION.

In the design and constructions of this engine it is at once apparent that modern ideas have been followed. Of the vertical type, it will permit of a most economical use of floor space and the reputation of the engineers of the company is a sufficient guarantee of its efficiency. Its outlines are neat and graceful and indicate strength and rigidity. The stairways and galleries are attached to the engine in such a way that all parts are easily reached. The building of this plant and its operation will receive the general attention of railway engineers, as it tends to show the greater or less saving in the operating expenses by this method of rapid transit in the large cities.

The method pursued by M. Baum for the production of incandescent lamp filaments which will stand a high temperature is given by a contemporary as follows: Organic fibers first treated with phosphate ammonia, hydro-chlorate of ammonia, calcium chloride and magnesium chloride. The salts of ammonia are volatilized and the filament is formed of the precipitated phosphates of lime and magnesia. The filaments are afterwards strengthened with a solution of gelatine and dilute carbonate of lime.

The Keystone Voltmeter and Ammeter.

The line of instruments here illustrated is manufactured by the Keystone Electrical Instrument Co., of Philadelphia, for which the Geo. L. Colgate Company, 136 Liberty St, New York, is selling agent. The design of the ammeter shown is especially neat and ornamental. The case is substantially made and dust proof. The scale is large, being about 12 inches long and is clear and easily read. A very fine reading may be taken as the eye can easily divide a number of times the spaces on the face.



THE KEYSTONE VOLTMETER AND AMMETER.

These instruments are particularly adapted to central stations and isolated plants where good and reliable instruments are demanded. They are free from heating errors and magnetic lag and are therefore very reliable. The moving parts are mounted in jewel bearings which secure a durability to the wearing parts and no appreciable error from friction. The mechanism involves no springs or permanent magnets and, therefore, will not deteriorate. They can be relied upon to maintain their accuracy. The voltmeters are of high resistance and require a minimum amount of current.

The style of instrument shown is known as type K; other styles are also made, in which the design of case and some minor details are different. The instruments are easily mounted on the switchboard. Screw holes are provided in base of instrument, and the only directions to follow are to have the instrument plumb. Before leaving the factory each and every instrument is calibrated. It is then sealed and has a card attached giving the number of instrument and certifying to its corrections.

The Columbia Street Car Register.

In the accompanying cuts are shown the details of a street car register, an invention which has been brought to its present state of perfection by Mr. Wm. D. Forbes, and is now manufactured by the Columbia Cash Register Co., of 1300 Hudson St., Hoboken, N. J. It has been one of the aims of the inventor to reduce as much as possible, the number of parts and to produce a machine that is simplicity itself. In doing this, however, he has not neglected the important functions of the register. A glance at Fig. 1 shows the extreme simplicity of the mechanism. One might suppose that behind the large gear there was a complicated train of gears and springs such as is usually found in devices of this kind, but such is not the case. The single piece shown in Fig. 2, and the spring wire that lies across it, are all the parts.

When the operator pulls the cord, this bar is drawn up and the entire mechanism actuated. The pawl shown at the bottom of the bar and attached thereto engages a tooth in the large gear wheel and causes it to rotate the length of one tooth. At the same time the bell hammer is raised and is then released, the spring of the hammer arm forcing it against the bell. There are one hundred teeth on this larger gear, and it is geared with a smaller one having ten teeth which lies behind the small cylinder shown in the lower right hand part of Fig. 1. This cylinder is always in mesh with the larger one, and it is evident that any motion imparted to the larger one must be transferred to the smaller one. When the large gear wheel has made one revolution the smaller has made ten revolutions. The small gear carries a disc having on its perimeter the numerals from one to ten, and this disc imparts motion at each revolution to a third which results in recording consecutively and continually the number of times the bell is rung or the large gear wheel is turned one tooth. The face of the disc shown in Fig. 3, shows that one hundred fares can be recorded on it. When over one hundred fares are reached a small dial at the right shows the number of

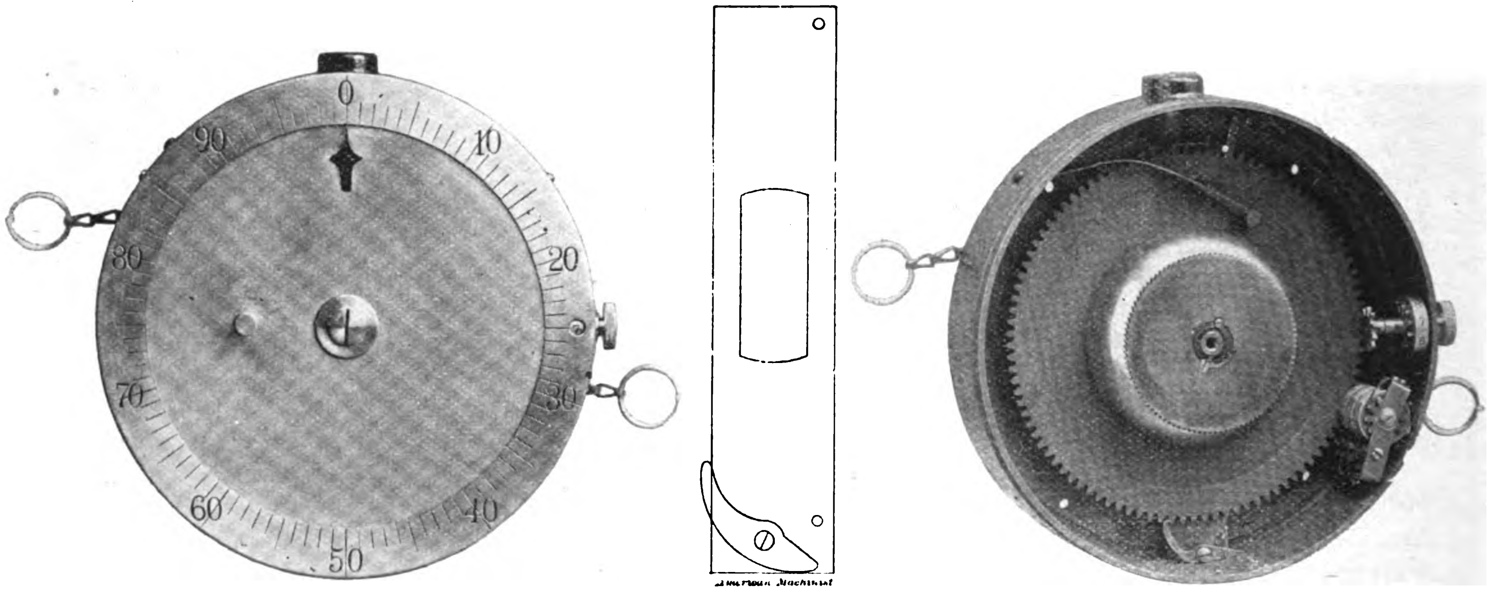


Fig. 1. Fig. 2 Fig. 3.

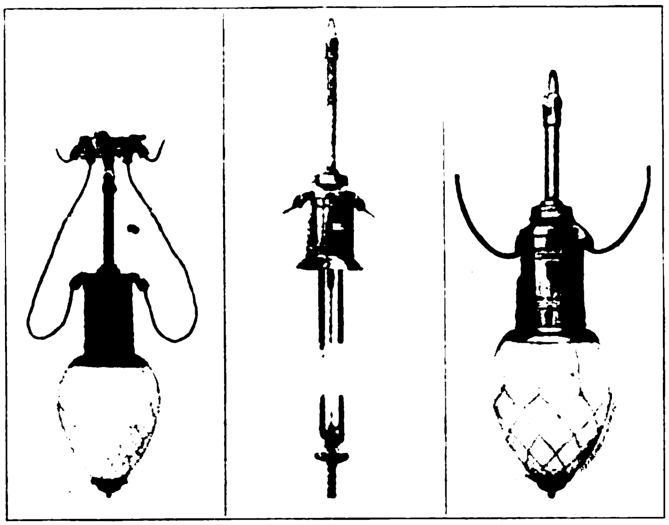
THE COLUMBIAN STREET CAR REGISTER.

hundreds. When the end of a trip is reached, it is customary to turn the dial back to O, and to do this the little knob shown in Fig. 3 is pressed in and the dial is free to revolve. This does not affect the consecutive registering apparatus which is always in operation. The record made by this part of the device cannot be changed except by destroying the machine or taking it apart.

The register is well made mechanically, and will withstand the effects of a long term of service. It is exact and reliable. The case is strong and substantial and is easily attached to car. The dial is of a sufficient size so that the numbers are large and easily distinguished.

Westinghouse New Arc Lamps.

Since the Westinghouse Electric & Manufacturing Company entered the field with its new direct current arc lighting machine, the company has also paid especial attention to the construction of arc lamps. The result has been that the company is now putting on the market a very extensive number of different styles of lamps which may be used for all purposes. In fact, the Westinghouse company now makes arc lamps which can be advantageously used where hitherto incandescent lamps were operated. These new lamps have all been thoroughly tested, and they are the outcome of considerable experimenting on that line.



FIGS. 1, 2 AND 3.—WESTINGHOUSE NEW ARC LAMPS.

Those intended for indoor operation are of a very ornamental design; they burn evenly and absolute absence of noise is one of their noteworthy features.

Those intended for outside use are also made with a view of meeting every requirement of a first-class arc lamp. The company has already a number of orders for installing these lamps, and wherever they are in operation the demand for them has considerably increased.

The accompanying cuts show the lamps for the three different systems of lighting. Fig. 1 is the constant current lamp, Fig. 2 the constant potential lamp, and Fig. 3 the alternating current lamp. The cuts are so arranged that they show the three lamps together for comparison.

Among the new applications of the art of electro-plating is its use for sealing bottles of wine or liquors. The mouth of the bottle is first covered with a suitable layer of conducting material, and then placed in the plating tank, where it receives a coating of metal.

An Elwell-Parker 200 Horse-Power Alternating Current Generator.

In the accompanying cut is presented one of the many types of electric generators manufactured by the Elwell-Parker Electric Company of America at the works of the company at Cleveland, O. The electrical apparatus of this company has been long in use on the other side of the Atlantic, where it ranks as one of the best on the market, but is comparatively new to American users. The prestige it has gained in the years of successful service will commend it to the trade in this country.

The line of apparatus is complete in every respect, and each individual type has demonstrated the efficiency of the design. The machine shown herewith has a capacity of 200 horse-power, and is now in use in numbers of the larger stations not only in England, but also in other European countries and the many English colonies. It is especially adapted for stations supplying a widely distributed district, or where station is at some distance from district supplied. Its design is such as permits the voltage to be made whatever the service of the particular plant requires. The mechanical part of the generator is well designed. The bearings are large and well supported. The base is broad and the details of the smaller parts are well worked out. The windings are well protected, and in this the appearance of the machine differs greatly from those of American design. Its general appearance, however, is neat and favorable to the electrical efficiency and mechanical strength. This is a point that is usually well understood by designing engineers, for it carries much of the success of any line of machinery.

It differs from those of usual American manufacture in that the field magnets are revolved inside of the stationary armature. The rotating magnets consist of a number of soft wrought iron poles bolted to mild steel rings, carried upon a cast iron center fixed by keys and set pins to the shaft. The stationary armature allows of the use of laminated iron cores of large section, and affords facilities for insulation not possible with a revolving armature.

The copper conductor is insulated from the armature core; this again insulated from the frame of the machine, thus giving a double insulation between the conductor and earth, a feature of great importance where high electromotive force is used. The clearance between pole pieces and armature coils is small.

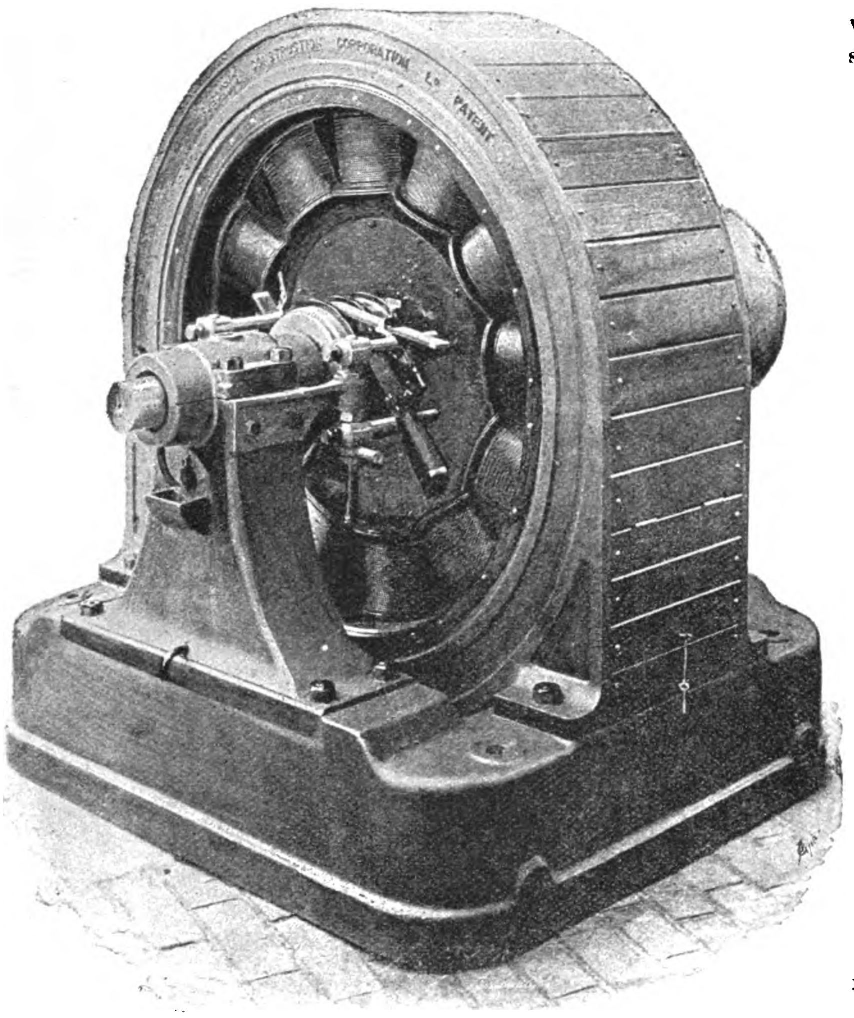
The armature coils are flat, and any coil can be removed for repair without disturbing any other part of the machine. They are built in such a manner that great flexibility is obtained for various speeds or voltages. The main terminals are mounted upon slate bases, these being enclosed by a wooden lagging, reducing the possibility of accident from touching the high tension circuit.

Terminals are provided for connecting voltmeters or regulators across any one or two of the armature coils. The machines are usually separately excited by continuous current dynamos, driven from small pulleys, provided on the alternator shaft. The exciting current is taken to the revolving field coils through ring collectors. In the standard pattern machine, the pulleys are overhung, but outside bearings are provided where required.

Where direct connected machines are desired, the engine shaft and bed plate are extended to receive the dynamo, and the exciter either run from the balance wheel of the engine or connected directly outside of the engine bearings. The machines are wound for any voltage trom 50 to 3,000 volts, and from 6,000 to 15,000 alternations per minute. The speeds at 7,000 to 8,000 alternations are about one-half that usual in this country. For instance, a 600-light machine runs at 600 revolutions per minute, with an exciter speed of 1,000 and the 2,000 light machine at 400 revolutions, with an exciter speed of 800.

The use of 7,000 to 8,000 alternations is advocated by this company, as this low periodicity gives greater flexibility in the running or arc lamps and other devices. The machines are practically noiseless. The electrical efficiency is very high, being in the medium sizes, 96 per cent.

The Manchester Square station in London contains ten-100 K.W. alternators, directly coupled to Willans engines, operating at a speed of 350 revolutions per minute. The exciters are all direct connected to Willans engines. They also have a large central station in Madrid, Spain, operated by Corliss engines and rope drive, which latter is preferred in England to the use of belts.



AN ELWELL-PARKER 200 HORSE-POWER ALTERNATING CURRENT GENERATOR.

The Elwell-Parker company has large shops in Cleveland, and intend making a specialty of the larger class of alternating work, with a special view to direct connecting to high or low speed engines.

The western agency for the electrical apparatus of the Elwell-Parker Electric Co. of America has been placed with J. Holt Gates, of Chicago, who is well known to the trade.

The Canadian patent on the Edison incandescent lamp expired on Saturday, November 17, and according to previous court decisions the United States patent expired at the same time.

Instrument Department of the Standard Electric Co.'s Works.

In every electrical installation the instruments for measuring and regulating the electric current and for inspecting the condition of the systems of distribution, form an essential part of the equipment. They are as necessary to the electric generator as the steam guage to the boiler. On the excellence and reliability of these instruments depends the efficiency of the plant. The first instruments manufactured were necessarily small and delicate to measure the feeble currents then obtained, but as the electrical industry has been developed the instruments have grown in size and multiplied in number.

In the manufacture of electrical instruments a special skill and an accuracy of workmanship is demanded which will produce in standard sizes the delicate parts of the instruments. In assembling and calibrating the instruments there is also required careful adjustment and an accurate use of standardized instruments. The manufacture of electrical instruments and regulating devices has become a special industry and is a separate department in the larger electrical works. In the instrument department of the Standard Electric Co.'s works at Chicago, instruments for all kinds of electric currents in commercial use are manufactured, together with a complete line of switchboard devices.

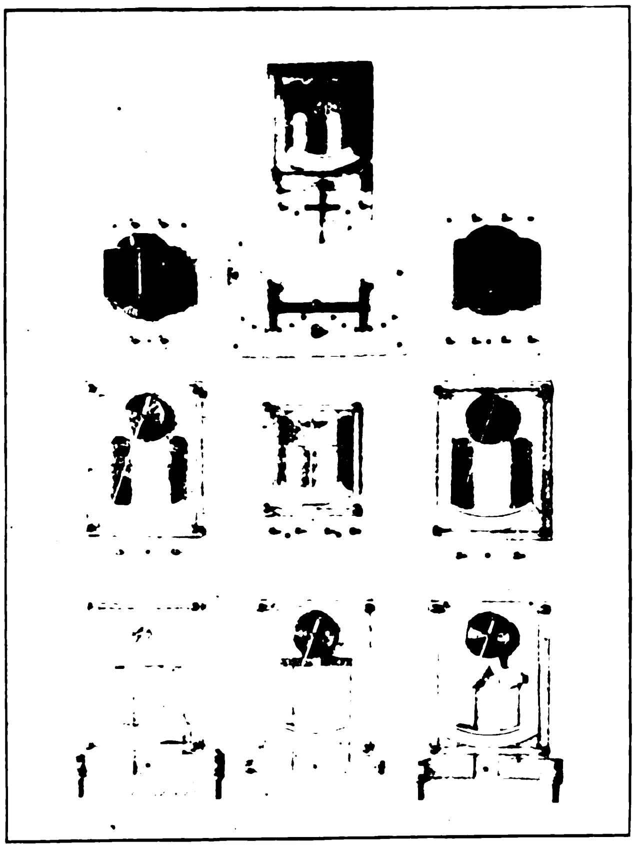


FIG. 1.—INSTRUMENT DEPARTMENT OF THE STANDARD ELECTRIC CO'S WORKS.

The designing of these instruments was the result of two years' work on the part of Mr. C. E. Woods, the electrician of the Standard company. It was one of the aims sought to produce a moving system for all measuring instruments which would have the same general features. This feature gives a uniformity in the appearance of the different instruments which produces a neat effect on the switchboard.

It also stamps each instrument as of Standard make. The general design of the instrument cases and methods of mounting is illustrated in the accompanying cuts. Pure white Tennessee marble is used for the bases unless specified otherwise. This marble is generally considered as one of the best for electrical purposes, being free from the veins of foreign mineral ores, which in other marbles frequently short circuit the board when use for high voltage currents. The cases are made of heavy plate glass with beveled edges. Dust proof and held firmly together by brass screws, the case is one of the best that could be devised for this class of instruments. It gives a clear view to all sides of the working parts.

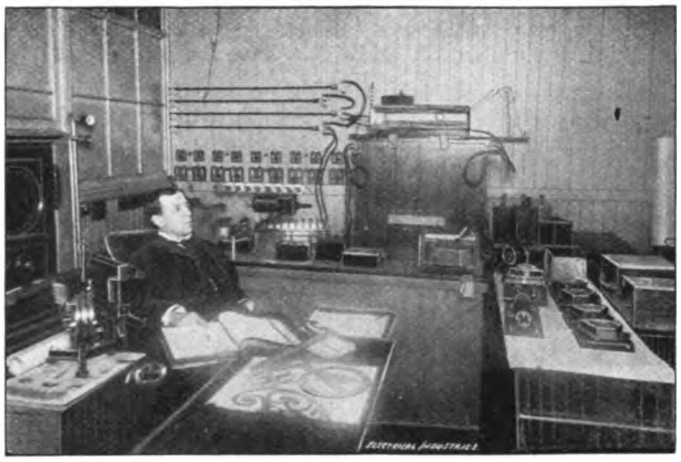


FIG. 2.—INSTRUMENT DEPARTMENT OF THE STANDARD ELECTRIC CO.—MR. C E. WOODS IN LABORATORY.

The constructing department is equipped with every facility for the production of a high grade of instruments. Fine watch factory lathes and other tools permit great accuracy even in the delicate parts of the instruments. The men employed have had a long experience in the manufacture of instruments. All parts are made to standard guage so that it is a simple matter to duplicate a single part or the entire instrument. The material used in the construction of the voltmeters and ammeters is uniform in character and must reach a high degree of purity before being accepted for the work. Most careful attention to the selection of material has aided greatly in the successful production of this line of instruments.

Where the instruments are assembled in the workrooms they are roughly calibrated, but the testing and accurate calibration is done in the company's laboratory. Here they receive the inspection of the electrician of the company and are calibrated under his supervision. The laboratory is equipped with an exceptionally full line of standard instruments of all kinds, and it is doubtful if there is another as complete a collection of electrical instruments in the West outside of the universities. The equipment includes much apparatus for experimental work and for special investigations. The laboratory is provided with means of instant communication with the dynamo testing, the instrument and other departments of the works. It is supplied with current from the dynamo testing-room which is used in testing the instruments. All readings from dynamos in dynamo testing-room are made there. After being accurately calibrated the instruments are left in circuit for several days, and when they leave the laboratory they are perfect in every respect, otherwise they are returned to workroom.

The standard station instruments manufactured are shown in Figs. 1 and 3. Both alternating and direct or continuous current instruments are shown in Fig. 1. The uniformity in design is at once noticeable. The instruments are made for connections on back or front of switchboard as may be desired. The instruments here shown are made fo connection on front of board. It is the more general practice where connections will permit it to keep the front of the board free from wires and connections, but often it is impossible in meeting the conditions at hand.

In Fig 3 is shown direct current instruments for central or power stations. The ground detector shown at A is of a recent design, improvements having been made in the details of construction, and also in the switch, which permits it to be used as a differential instrument by throwing either side into circuit. The coils are wound with a specially fine grade of silk insulated wire and are made to a standard size. The scale as shown is marked so that one not familiar with its construction will know whether the ground, if one exists, is of such a nature as to require its being thrown out until repaired. By the use of a compound switch the instrument is used with any number of circuits.

At B Fig. 3 is shown the voltmeter which is used for either direct or alternating currents. It has also been greatly improved, the coils being somewhat different from those in the voltmeters first placed on the market. The instrument is a perfect instrument of its kind and is not only accurate through the range of machines it may accompany but through the entire range up to the limit of its capacity. The coils are wound with a double wire to obtain a non-inductive result.

The ammeters shown at C and D Fig. 3 are, although of the same design, for different capacities, as the scales will indicate. In the mechanical construction of its moving parts it is the same as the voltmeter. Ammeters of this design are made up to 1,500 ampere capacity. The results obtained with these instruments have been very satisfactory and a reputation for accuracy has been maintained.

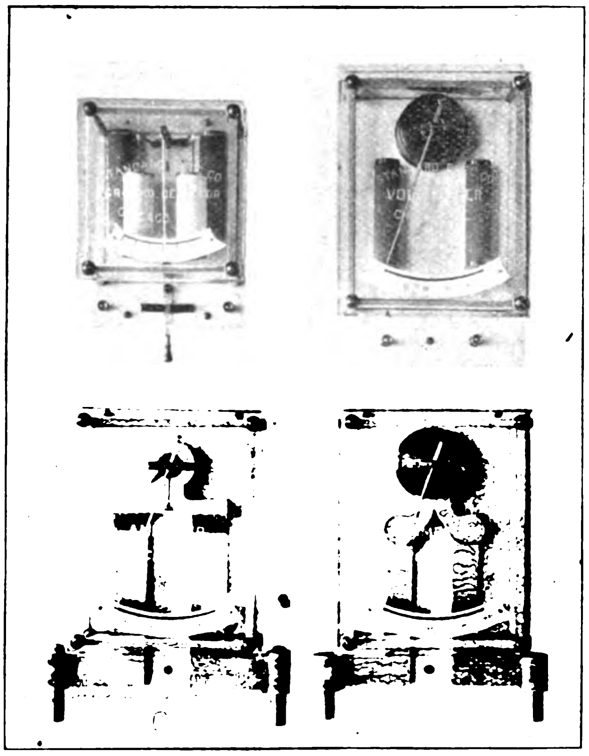


FIG. 3.—INSTRUMENT DEPARTMENT OF THE STANDARD ELECTRIC CO'S WORKS.

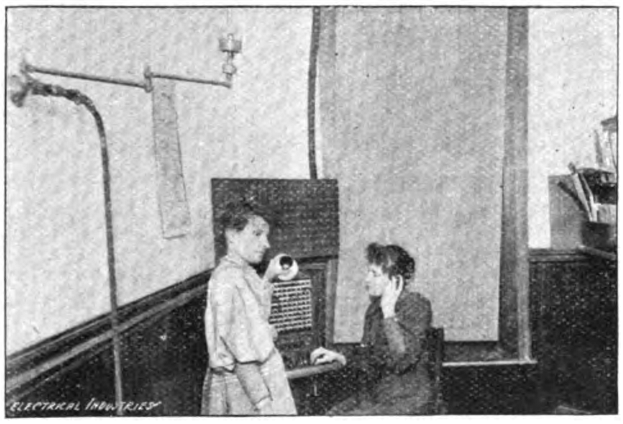
Closely connected with the instrument department is that devoted to the construction of switchboards and switchboard appliances. Here the switchboard is set up complete with every instrument and connected in place, and when everything is fitted and tested it is then taken apart and packed for shipment. Switchboard transformers, switches, bus bars, connectors of all kinds, etc., are manufactured to conform to the requirements of the station. Made in orignal designs these appliances give a neat an ornamental appearance to this important part of the electrical installation.

The Decatur Telephone Exchange.

The new telephone exchange installed by the Western Telephone Construction Company, of Chicago, at Decatur, Ind., is in operation. The illustration shows an interior view of the central office with the day and night operator present. The great compactness and economy of space of this switchboard is apparent at a glance.

Over in one small corner of the room, occupying practically no space, stands the switchboard with the transmitter presented before it. A wonderful change in dimensions is shown in this 100 subscriber switchboard. Other switchboards of the same capacity would occupy almost the entire side of the room and would ordinarily require an operator to move from board to board to make connections. Here the operator sits with the head-band attached to the receiver which is held thereby to the ear. An extended shelf holds the plugs attached to cords and in front of them are the circuit changing devices, which are extremely simple.

When a subscriber calls, a little shutter falls down in front of the spring-jack. The operator thereupon raises one of the plugs, presses it into the jack, which same movement restores the shutter to its normal position. She then says, "What number." The calling party gives her the number wanted; she takes the plug, attached to the other end of this cord, and inserts it in the spring-jack of that number; pulls one of the small levers in the front of her slightly forward and the connection is made.



THE DECATUR TELEPHONE EXCHANGE.

This is a simplicity itself as compared with the old method of inter-connecting subscribers in a telephone exchange. When the parties connected finish talking, a slight ring by either party drops another shutter below corresponding with the pair of cords connected. This indicates to the operator that they have finished talking or wish her attention again. Another little push of the lever recommunicates with her head telephone and the subscribers. She speaks and if she obtains no answer, presumes that they have finished and pulls the plugs out.

The Decatur, Ind., exchange was organized on the co-operative plan. About fifty-two people there decided that they wanted telephones. Each one took a certain amount of stock in the corporation equivalent to his proportion of its cost. At first there were doubts and fears as to whether it would be profitable and of sufficient value to warrant the outlay. Some were timid about going into it; threats of patent difficulties were presented, but the fifty-two were found willing to invest.

As the organization progressed, a greater feeling of confidence prevailed and others wanted telephones. The demand then showed sufficient and the first fifty-two deemed it advisable to hold all of the stock and exact a rental from all others who came in, the profits from the late-comers inuring to the benefit of those who had a stock interest.

Quite a number of additions have been made to the exchange since it first started and it is continually growing. The people are very much pleased with the operation of the telephones and speak in the highest praise of them. The telephones in use are the number one dynamic type of Western Telephone Construction Company's manufacture.

Train Lighting by Electricity.

The length of many of the European railroads and the fact that the trains as made up at one terminus of a road continues the same until the other is reached are conditions that are especially favorable to the use of electric lighting on European railroads. The system of electric lighting as used on the Danish State Railroad was recently discussed by the Institute of Civil Engineers. The lamps used are eight and five candle-power incandescents. In each first-class compartment are placed two eight candle-power; the second-class and lavatories are fitted with two five candle-power lamps and in the third-class compartments are three five candle-power lamps.

Current is supplied from a storage battery plant of thirty-three cells with three extra cells as a reserve. The total capacity is 80 ampere hours and maximum discharge is 18 amperes. Each cell has fifteen plates, eight negative and seven positive, and weighs about 50 pounds. The cars are wired complete and are fitted with flexible connections so as to supply a number of cars or carriages from one battery plant. The batteries are charged from the lighting plant at the terminal station. The cost of equipping a train is given as follows:

	£	s.
Coach with two first-class, two second-class compartments, and two lavatories	21	10
Coach with two second-class and three third-class compartments, also one lavatory	20	0
Coach with five third-class compartments	16	10
Luggage van	15	0
Battery, switchboard, etc	128	5

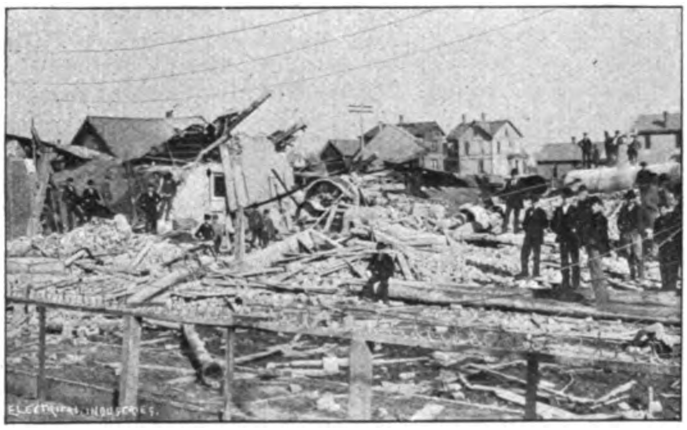
The total cost of a train made up of four first and second-class, three second and third-class, five third-class and one baggage with two sets of batteries would therefore be £500. The total illuminating capacity of such a train is 618 candle-power, requiring about 33 ampere hours with the battery voltage. The hours of lighting do not exceed 1,000 per annum and the cost of electrical energy per lamp hour is given as 0.14 cents. This system has been in use about two years, a sufficient time to show the running expenses but not the depreciation and cost of repairs.

A method of concentrating sulphuric acid by electricity is said to have been perfected by Johnson & Matthey, of London. The acid is heated by coils of platinum wire suspended in the acid, through which a current of electricity is passed.

A Disastrous Explosion at the Power Plant of the Elwood Electric Street Railway.

The explosion of one of the boilers at the power plant of the Elwood Electric Street Railway at Elwood, Ind., on the night of November 16th, brought almost complete destruction to the buildings and contents. The power house contained not only the street railway plant but also the electric lighting station by which the city was lighted. The destruction of both plants deprived the city of both lighting and street car service.

The explosion happened at 11:35 P.M., at a time when the load must have been light, and occurred without warning. The engineer in charge, Norman Clark, a young man about 23 years of age, was killed. The entire machinery in the power house is almost a total loss. The fittings of the engines and other machines being broken and twisted so that they will require rebuilding. The electrical instruments and appliances are a complete loss, and dynamos will probably be sent to factory to be reconstructed. The building and a fifty-foot brick stack were leveled to the ground. The car barn was separated from boiler room by a brick wall, but the four motor cars which were there at the time are complete wrecks, so much so that their value would not be placed above $50.00, aside from such trimmings as can probably be used again. The boiler that exploded was erected in 1891. It was purchased of Russell & Co., of Massillon, Ohio. It was a horizontal tubular boiler 16 feet long by 66 inches. The pop-valve was set for 97 pounds. At the time of the explosion the glass guage showed safely two guages of water. As to the cause of the explosion the company has not been able to arrive at any conclusion as yet. Another boiler very close to the one that exploded did not explode and appears to be in fairly good condition.



A DISASTROUS EXPLOSION AT THE POWER PLANT OF THE ELWOOD ELECTRIC STREET RAILWAY.

The loss to the power station is variously estimated from $15,000 to $25,000, a careful estimate not as yet having been made. The damage to surrounding property is considerable. Glass plates were broken several blocks away from the shock and pieces of the boiler were blown several hundred feet.

A peculiar catastrophie is reported from Cobden, Ont. The electric lighting station was located on Gould Creek where sufficient water power is secured to operate the plant. The station and dam were but recently built. The dam gave way during the night the first of the month and the flood carried the station out into Muskrat Lake. The watchman escaped with but few injuries from the timber and wreckage.

ODDS AND ENDS.

The car barns of the North East Street Railway Company, of Kansas City, Mo., containing 13 motor cars and a large amount of stock used in the repair and construction of cars, were burned on November 7. The barns will be immediately rebuilt.

Pittsburg is one of the latest cities in which the trolley cars are being used by the postoffice department for carrying the mail. The first car was placed in service last month on one of the Duquesne company's lines and carries mail to East Liberty. This is only the beginning of a more extensive use of trolley mail cars in that city.

Municipal lighting in England is not as rosy as it might be, according to recent reports. The station at Cardiff was planned to supply a large amount of commercial lighting in addition to the lighting of the streets, but up to the present time applications have been made for but 500 incandescent lamps, an insignificant part of the capacity of the station.

The Manhattan Elevated Railway, of New York, is, according to a reported interview with Russell Sage, to be double decked and electricity is to be used as the motive power. The upper structure is to be used for express trains. With electricity as the motive power there will be no heavy locomotives used and the upper structure can, therefore, be built much lighter.

The people of New York voted to construct at public expense an adequate system of rapid transit. The rapid transit commission consists of Alexander E. Orr, Mayor Gilroy, Seth Low, A. P. Fitch, John H. Starin, William Steinway, Judge Henry R. Bennan, John H. Inman and John Claflin. Work is to commence immediately upon the laying out of the routes and the construction of the roads.

The new trailers that are to be run on the Twenty-second St. line of the Chicago General Street Railway are models of their kind. They are being built at the works of the Pullman's Palace Car Co. The cars are vestibuled, 40 feet long over all. The vestibules are five feet wide, and are inclosed on three sides, so that there is but one entrance, and that on the right side. The entrance at the front of car is to be closed and that vestibule to be used by smokers. The cars will seat 42 passengers and will be well lighted with electric lights.

The new steamship St. Louis, launched the 12th of last month at Cramp's ship-yard, Philadelphia, is to be equipped with 1,200 electric lights. The wiring will be done in accordance with the latest ideas and the fittings will be in touch with the magnificence of other parts of the ship. This vessel is the fourth largest ever launched and is next in size to the Lucania and Campania, the largest now afloat. It will carry 1,320 passengers. The St. Louis belongs to the Red Star line, and will soon have a companion, the St. Paul, now building.

The report of the Consolidated Street Railway Company, of Worcester, Mass., shows receipts slightly in excess of those of the previous year. The operating expenses were $284,214.92 and the total net income over operating expenses $70,784.63. The charges on income during the year have been interest, $27,621.42; taxes, $15,613.56; rentals, $2,243,54, making a total of $45,478.52. The number of passengers carried was 7,293,410. In the improvement of rolling stock, track lines and buildings there was expended during the year $129,277.18.

LEGAL NOTES.

STORAGE BATTERY.

In the case of the Accumulator Company vs. The Edison Electric Illuminating Company and the Electric Storage Battery Company a decision was rendered on November 5th, by Judge Wallace, in the United States Court of Appeals, affirming the decision of Judge Lacombe. This decision enjoins the Edison Electric Illuminating Company, of New York, from using the chloride battery. An abstract of the opinion of Judge Lacombe was published in the November number of Electrical Industries.

TO ACCOUNT FOR STOCK.

A bill in equity was filed the earlier part of the month at Pittsburg by Robert S. Waring, against George Westinghouse, jr., in which he asks that the latter be compelled to account for 10,000 shares of stock of the Standard Underground Cable Company. The bill states that in 1886 Mr. Westinghouse took 5,000 shares in the company and that the plaintiff was induced to place 10,000 shares in the name and control of Westinghouse, for which he has received no compensation.

THE BATE REFRIGERATOR CASE.

On the fifteenth of last month the argument in the Bate Refrigerator case was commenced before the United States Supreme Court. While the case in question is over refrigerator patents, electrical interests are directly involved, as upon this decision depends the life of a large number of electrical patents. Important ones of these are the incandescent lamp patent, over the litigation of which hundreds of thousands of dollars have already been spent, patents owned by the Am. Bell Telephone Co., the Western Union Telegraph Co. and many others. In the list of attorneys that appear in this case will be noticed some of the best patent lawyers, and the attorneys of the different companies whose interests are directly involved. On the side of the Bate company appeared James C. Carter and C. E. Mitchell and on the other were Wheeler H. Peckham, Edward Wetmore and L. E. Curtis. B. F. Bristow, of the Harrison Telephone Company and Ex-solicitor General Aldrich, were permitted to file briefs as their clients had interests which were liable to be affected by the decision.

The question in dispute is as to the limitation of United States patents by a prior foreign patent. It is contended that section 4,887 of the revised statutes, limits the life of the American patent when the foreign patent precedes the American application, while the defense claims that it applies whenever the foreign grant precedes the American issue. The latter claim has been sustained by previous decisions of the lower courts, but the point has never been passed upon by the supreme court.

The original suit of Bate Refrigerator Company vs. Sulzburger et al., reached the supreme court in 1889. In this case counsel for the Westinghouse and other companies filed briefs. In the decision the Supreme Court of the United States found it unnecessary to consider the contention of the Bate company, that the language of Sec. 4,887 of the revised statutes should be so construed as to free any American patent from limitation by the term of a foreign patent, if the American application antedated the foreign, although the foreign patent was granted earlier than the American. An opinion is now sought on the question that the court omitted to deal with.

In the argument for the Refrigerator company it was contended for a liberal, rather than a literal interpretation of the law in the case, and argued a system which between individuals would offer a reward for a service and then abridge it for such reasons as those contended for in the present case, would be dishonest. It was further contended that it was preposterous for the government to impose the penalty of the loss of the three most useful years of an American patent because a foreign government had been more expeditious in granting a patent, when the fault of this delay rested with the American government itself. To protect his patent abroad the inventor applies for a foreign patent, and in doing so cannot well imagine, if the foreign patent should be issued in advance of his American patent, his rights in his own country will be abridged or any damage would arise in his interest. Previous to 1876 when Mr. Bate applied for his patent, the attorneys claimed no hostility had ever been shown by our patent system to the obtaining of patents abroad. On the contrary, that practice, while never disfavored, had been distinctly encouraging since 1836 by our law, both because it furnished an additional stimulus to invention and prevented disadvantage to American users, which came from their being under the burden of a royalty when the users are exempted from it. A whole generation has become used to the fact that after a man had made a petition for an American patent, his rights were safe except through acts of his own. The defects in the patent system as respecting foreign and American patents and the remedies provided by the laws, were reviewed by the defense. The usual construction of the statutes was stated and a liberal construction by the court such as would benefit the American public, was contended for. A decision is looked for at an early date.

CORRESPONDENCE.

LETTERS FROM PRACTICAL MEN.

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay and in this way the value of this column to every one will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—Ed.]

Editor Electrical Industries.—We have an L. D. 12 T.-H. 50 light arc machine that is giving us considerable trouble in the way of the shaft and spider in the armature getting very hot on short runs of say two to three hours; we have done everything we can and still the heat continues. First, we reinsulated core with asbestos, mica, canvas and tape and put on new set coils. Second, there is apparently no short circuit or ground on machine, and amperage holds steady at 6.8 amperes. The lamps and line are in good condition. The cut-out is properly set. The heat is not caused from bearings for the most heat is nearest spider. Core and coils do not heat excessively, but get hotter in three hours run than a 30 light Ball automatic all night. We have made a great many tests for grounds, short circuits, etc., but have never yet found one. Respectfully,

Greensboro Elec. Lt. Co.

Greensboro, N. C., Nov., 17, 1894. R. J. Marks, Man.

[The heating is undoubtedly due to Foucault currents in core and spider resulting from imperfect lamination. When field is magnetized and there is no load on armature it will be noticed that a considerable power is required to run the dynamo. The fault is probably in the first construction of the machine and not in anything subsequent. The only remedy is in reconstruction.—ED.]

A BRIEF REVIEW.

THE FUTURE OF THE ELECTRIC MOTOR.

All that the telegraph and telephone have done in winging our spoken and written words has been paralleled in another mode of intercourse by the electric motor. A good many prophets have imagined that this invention, by laying on cheap power at the artisan's threshold, will abolish the factory; that, indeed, we are on the eve of the return to the old methods of weaving, cabinet making, and so on, at home. But a factory does not thrive because each of its machines is near a steam engine or a water wheel, but because every one of these machines can deliver its product to a sister machine at its side. The processes performed in a shoe factory or a gingham mill could not be economically conducted in scattered homes even if motive power there cost nothing at all. Not in manufacture, but in transportation, is it that the electric motor emancipates the workingman. In cities its cheap and quick transit enables him to bid good-by to the tenement house and live in a sunshiny cottage of his own. If he lives and works in the country the same good servant gives him ready access to the city, with all that that signifies of mental stimulus, of better reward for his labor. Electric lines, at first suburban, are now fast knitting together cities 50 to 100 miles apart. Nor need the steam roads look askance at this rivalry. Electric lines act as feeders for them in many districts too poor or too sparcely settled to support a steam service. Great as are the benefits which electricity brings to country folk, it is in the hives of population that it stands ready to do its best work. Unwittingly your electric engineer is a municipal reformer of high degree. Every building in New York has its Croton water delivered at a charge vastly lower than if the supply were competitive and confined to a small part of the city.

And what is true of New York is true of all our cities, and so in the course of time we shall witness the common and cheap introduction of electricity to every household where it is needed for use as a motor or for light making. This will not by any means necessitate the abolition of gas, but will be the means of producing artificial light, gas or other, at the lowest cost.—World's Progress.

STEAM ELEVATED ROADS ARE DOOMED.

The publication, this week, of the financial reports of the Manhattan Railway Co. (elevated), and of the Third Avenue Railroad Co., which started up its cable road early during the present year, brings out the facts that warrant the closest study by all engaged in street railway work, as they point unmistakably to a condition of affairs bearing directly on the future of street railways in general and elevated railroads in particular. Shortly after the Broadway and Third avenue cable roads were put in operation in New York it began to be commented on that they were drawing traffic from the elevated roads, but just to what extent was not positively known until this week, when the reports above alluded to were made public. From them we learn that the gross elevated earnings for the year ending September 30, showed gross earnings of $10,138,143, a decrease of $948,216, or nearly 10 per cent! The operating expenses amounted to $6,095,557, an increase of $509,257; and net earnings were 4,042,586, a decrease of $1,457,473. The operating expenses, it is but fair to state, last year included taxes, which they did not cover in previous years. The percentage of operating expenses (including all taxes) to gross earnings was 60.12 per cent, against 53.90 in 1893. Comparing these figures with those of the Third avenue cable road, we find: Received from passengers, in 1894, $2,007,804.83; in 1893, $1,653,539; increase, $354,265. Operating expenses, in 1894, $1,070,965; in 1893, $1,188,235; decrease, $65,670. Net income in 1894, $635,004; 1893, $309,068; increase, $325,936. Dividends, 1884, $560,000; 1893, $240,000; increase, $320,000. These figures require little comment, but the lesson they point out will, we hope, not be lost upon the elevated railroad company. Lulled hitherto into a condition of lethargy, to say the least, by the absence of competition, they must recently have awakened to the fact that even the seemingly slow street car line, when it gives the public all the advantages and comforts of well-heated, lighted and ventilated cars mechanically propelled, can become a dangerous rival. The results have been the same in Brooklyn, where the elevated has fought a losing battle with the trolley. As to the manner in which the elevated railroads propose to regain the ground lost, it seems to us that there is only one way, and that is, the equipment of their roads with electric motive power. We believe the company can afford to throw away its entire present locomotive equipment—each locomotive costing $1,000 a year for repairs according to figures of recent reports—and save money in operating expenses by erecting large generating plants and operating motor cars. The introduction of electric elevators at all stations would also remove an objection raised by many to the use of the elevated. The experience obtained with the Intramural Road at the World's Fair last year has settled that question once and for all, and the Liverpool road now running and the equipment of the Chicago elevated roads now in progress is a conclusive argument in proof of our assertions. The elevated roads in New York discharge an important function and will continue to do so in spite of all surface road or underground competition, and it would be a pity to see them fall short of their true value and become a burden instead of a source of profit to their stockholders. Let them adopt electricity and all may yet be well.—Electrical Engineer.

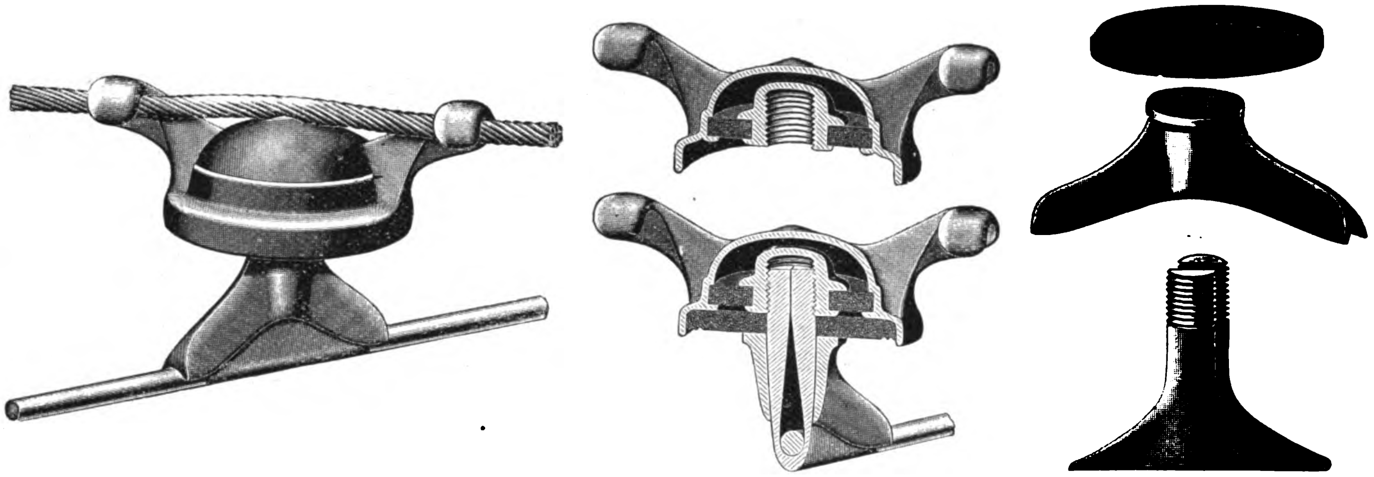
ELECTRICAL MUSCLE MAKING.

In our issue of August 11, we published a short filler under this heading, based on an abstract in the Digest of the preceding issue under the heading "Electricity in Therapeutics." As these brief abstracts have since been reprinted in other papers, and judging from the number of inquiries we have received, have been of special interest to a large number of readers, and as the matter from which this was taken was published in an English journal that may not be accessible to many, we reprint below the whole editorial on this subject which appeared under the heading "Electricity in Therapeutics" in the London Electrical Review of July 13. Those specially interested will do well to read the original French article.

"Electricity has been used for many years in a rule of thumb fashion for stimulating the nutrition of the muscular system. It is quite time the matter were treated more scientifically. In the application of electricity to human diseases, there has always been too much of an appearance of quackery; and the "G. P." usually resort to it only as a last resource, without having any views or knowledge as to its precise action. Researches like those recently made by Debedat (vide Arch. d'Electricité Médicale, March, 1804) are calculated to change all this, and make electricity as certain a remedy as are the mercury compounds in cases of syphilis. The preliminary experiments were wisely made upon animals, rabbits being selected as the victims to science. The various kinds of electrical stimulation used in medical treatment were all tried, and the results of the investigation are now accessible. The groups of "hamstring" muscles were chiefly experimented with; those of the left side being stimulated daily for twenty days, four minutes per diem, and those of the right side being left for purpose of comparison. At the end of the period the animals were killed and the muscels of the two sides removed and weighed. Portions were also hardened and examined microscopically. The modes of stimulation were as follows:—(1) Induction-coil current; groups of shocks lasting each for one second and followed by one second interval of rest. (2) Galvanic battery current of 2 milliamperes with the same periods of stimulation and repose. (3) Static sparks of 2 to 3 milliamperes repeated every two seconds. (4) Tetanisation of muscles for four minutes by means of an induction coil without intervals of repose. (5) Steady galvanic battery current for four minutes without intervals of repose. The results showed a gain of 40 per cent of weight on the stimulated side of the animal with (1) the rhythmic induction shocks, and of 18 per cent with (2) the rhythmic battery current. The effect of (3) the static sparks, was nil. The prolonged tetanisation (4) caused a loss of weight. The prolonged steady battery current (5) caused a slight increase of weight. [Adhesions had been formed between the skin and the muscles at the points of application of the electrodes in this last series of experiments.] It is clear from the results of these experiments that the gain in weight of the muscles was due to a true growth of muscle; and that the loss of weight noticeable in certain of the experiments was accomplished by histological evidence of damage to the muscular fibres. Hence Debedat concludes that the most advantageous mode of promoting the healthy growth of muscle by means of electricity is to use an induction coil, and to arrange the periods of contraction and repose so as to approximate to the conditions of a muscle during the performance of rhythmic gymnastic movements, namely, about 30 periods of contraction and 30 periods of rest per minute. Prolonged tetanisation is distinctly hurtful, and this shows that the methods most commonly made use of by ill-informed practitioners and worse informed quacks are entirely wrong."—Electrical World.

Some Electric Railway Specialties.

In the construction of the electric railway specialties here illustrated, considerable ingenuity is apparent. Strength and perfect insulation have been kept in mind, and in securing these necessary qualities other important features have not in any manner suffered. Easy adjustment, convenience and quickness in attaching to trolley wire, is one of the qualities that will at once commend them to railway men. When attached they are securely locked in place, and will not work loose. The under surface of the trolley wire is left smooth and does not throw the trolley wheel as it passes.



SOME ELECTRIC RAILWAY SPECIALTIES.

The construction of the trolley hanger is clearly shown in the accompanying cuts. Of all overhead material, this is one of the most important and most used devices. Upon its strength and insulation depends the operation of the system. As will be noticed, this hanger is made up of four distinct parts which, when joined as intended, hold the trolley wire and themselves firmly together. In the cut of the bell, the insulating material and its arrangement is shown. The heavy insulating washer is held in place against shoulders on inside of bell by lugs which are cast onto the bell and then clinched down on the washer. The nut in the center fits into a square hole in inside of washer, and is held in place by flanged head on top and lugs underneath washer.

The trolley wire is held in a simple manner which prevents any possibility of the wire becoming loose. The clamp opens and encircles the wire and is then closed. The upper ends are passed through the saddle and a large insulating washer, and then the bell screwed down. The saddle is forced down on the trolley wire until the lower side of clamp is in align with the underside of trolley wire. This clamp, as shown in the cross section, is about one-eighth inch thick at the center, but tapers down to a knife edge at the ends. When the hanger is adjusted to trolley wire, the wire is slightly curved in the hanger and extends in each direction so that the lower part of hanger and wire are in a line. This a most important feature and one well worked out. The wear of hangers and trolley wire is largely caused by the arcing at the hanger caused by the trolley wheel being thrown from the wire after striking the hanger. When the hanger interposes no obstacle to the smooth and easy passage of the trolley wheel, the life of the entire equipment is prolonged; the constant breaking of the circuit cannot fail to have its effect on the motor equipment, and on the lines its effects are soon noticeable. Where smooth hangers are used, the wear is confined to that which results from the passage of the trolley wheel over the wire.

This specialty has been described as being the most important and typical of the general line of similar goods. The same principles are involved in the many styles of hangers. The single curve and double curve hangers as well as bracket hangers of various kinds, are made on the same lines. In the splicing plates and section insulators the same method of insulation is followed. These specialties have been in use a sufficient length of time to show their practical advantages. Simplicity of construction and durability have been sought in their design, and consequently very successful results have been obtained. These goods are manufactured by the Michigan Electric Company, of Detroit, Mich.

Attention has been turned during the recent years to the value of water power for the generation of electricity, in which form the energy is easily transmitted and utilized in many ways. According to English papers the fall of water at the southern end of Lake Windemere which is said to be the best piece of water power in England, is to be utilized by the erection of an electric station. The power is said to aggregate 40,000 horse power and will be distributed through the surrounding territory up to a distance of 10 miles. This indicates that the attention of English engineers is being turned to the advantages of the few water powers Great Britain possesses for the generation of electric power.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Benicia, Cal.—The Solano Electric Light Company will add a 100 horse-power engine and a 700 light incandescent dynamo.

Towson, Md.—The Mount Washington Electric Light and Power Company contemplates the erection of a new plant and equipment and will also wire for residence lighting. T. W. Offut is purchasing agent.

Kalamazoo, Mich.—The city will either build a lighting plant or else contract with some company to furnish same. Chauncey Strong is city clerk.

Aurora, Mo.—Mr. E. L. Foster will increase the equipment of his plant by adding an alternating machine.

Marceline, Mo.—The Merchants' Electric Company was recently incorporated and is now being organized. An incandescent plant will be installed when the station building is completed.

Mexico, Mo.—The Mexico Electric Light, Heat and Power Company is making extensions, and will soon double its present capacity. W. E. McCully is secretary and general manager.

Manchester, N. H.—The Union Electric Company may add a large generator for power purposes and an increase of incandescent lights.

Lambertville, N. J.—The Hunterdon Electric Company contemplates the installation of some motors for power and light purposes. Wm. B. Bratten, 413 Drexel building, Philadelphia, Pa., is purchasing agent.

New London, O.—The New London Electric Light Company will add to its equipment an incandescent dynamo, and also an arc plant. E. R. Stilson is purchasing agent.

Coalport, Pa.—The Coalport-Irvona Light, Heat and Power Company will construct a new and complete incandescent plant.

Etna, Pa.—The Etna Borough Water Works Corporation is preparing the foundation for an electric lighting station, which will probably be built next year. Address Charles C. Henderson, Burgess.

Oshkosh, Wis.—The Oshkosh Electric Light and Power Company will add a power generator for supplying electric power. C. C. Paige is president and purchasing agent.

West Selkirk, Manitoba.—The Selkirk Company (Limited) will soon double its present capacity. F. W. Hooker is purchasing agent.

Estherville, Ia.—It is expected that the municipal plant, which is nearing completion, will be ready for operation by December 10th next.

St. Charles, Mo.—The city plant is to have its equipment increased by the addition of several arc lamps. J. M. Wilderman is manager.

Rogers, Ark.—King Brothers, who were recently granted a 20-year franchise, have contracted for a 500 light alternating plant, which will be installed under the supervision of Mr. J. J. Sprague, electrical engineer. It is expected that the plant will be ready for operation by January next.

Luling Electric Light & Power Co., Luling, Texas.

Luling, Texas, Nov. 22, 1894.

The Electrical Industries Publishing Company, Chicago.

Dear Sir:—The Luling Electric Light & Power Company will receive bids on the following, to-wit:

One 50 to 65 horse-power boiler (first-class material) and one 50 to 60 horse-power engine, Corliss and automatic, including feedwater heater and pump complete. One 500 to 600 light alternating current dynamo, with exciter and switch-board complete. Transformers, assorted sizes for 300 lights, also 300 lamps, sockets, etc. One car Cedar poles, 25 feet long, 4 to 6 inches at top. Wire, both weather and fire proof, to install plant.

Certified check for $500 to accompany all bids, as a guarantee of good faith. The bids will be opened in the city of Luling between the hours of 10 a.m. and 2 p.m. on the 12th day of December, 1894.

This company will pay for the above as follows: 25 per cent on receipt of machinery, and the balance after operating the plant for thirty days. The company will agree to install this plant at the earliest practical moment after receipt of machinery. The company reserves the right to reject any and all bids.

Luling Electric Light & Power Co.,
F. R. Starr, Jr., *Manager.*

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

Mahanoy City, Pa.—The Lakeside Railway Company will extend its line to Lakeside, a distance of eight miles. Philander Betts is purchasing agent.

Jackson, Tenn.—The Jackson & Suburban Street Railroad Company is making arrangements to change its motive power from horses to electric and also to make some extensions. Pierce & Richardson, 1409 Manhattan Building, Chicago, engineers. J. H. Hunter is president and purchasing agent.

Ft. Smith, Texas.—Ft. Smith & Van Buren Electric Railway, Light and Power Company is building an electric road 6¼ miles long from Ft. Smith to Van Buren. Two and one half miles are now completed. Machinery for power station and rolling stock is to be purchased. The stockholders of the road are Ohio capitalists. Mr. M. N. Beaty is president, and manager, Ft. Smith.

Binghamton, N. Y.—An electric railway from Binghamton to Union, N. Y., a distance of 11 miles, will probably soon be built. A number of local and outside capitalists are interesting themselves in the project. It is proposed to carry both passengers and freight.

Binghamton, N. Y.—The Binghamton, Lestershire & Union Electric Railway Company has just received a franchise for the full length of its proposed line, of about twelve miles. It is to be single track, laid with T rails and equipped with first-class rolling stock. The management expect to have the road running before July next. Address G. Tracy Rogers, Binghamton, N. Y.

NEW INCORPORATIONS.

Bellaire, Ohio.—The Bellaire, Bridgeport & Martin's Ferry Electric Railway Company.

Georgetown, D. C.—Patomac Light & Power Co., capital $35,000. A. H. Wilder, V. M. Walkins, G. A. King and W. E. Harvey incorporators

Wheaton, Ill.—The Wheaton Electric Light & Water Company increase of capital stock $22,000.

Mound City, Ill.—Mound City Electric Light and Power Company, $50,000.

Detroit, Mich.—Rae Electric Manufacturing Co. F. B. Rae, president; F. H. Date, secretary and B. H. Scranton, treasurer.

Detroit, Mich.—The Universal Electric Construction Co., capital $25,000.

Dayton, Ohio.—Ohio State Hospital will put in a lighting plant. F. J. McCormick.

New York, N. Y.—Thompson-Brown Electric Co. to handle electrical supplies and apparatus, with capital stock, $25,000.

Los Angeles, Cal.—Electric Power Company, with capital stock $1,000,000. Peter Kehl, M. L. Graff and others.

San Francisco, Cal.—The Pacific Electric Company; capital $30,000. John T. Hogan, W. S. Beckwith and others incorporators.

Chicago, Ill.—The Dearborn Electric Co.; capital $25,000. T. C. Rafferty and Charles Messer incorporators.

Madison, Neb.—Madison Electric Light & Power Company; capital $10,000. Incorporators, H. E. Beck, W. V. Allen and others.

Terre Haute, Ind.—Citizens' Electric Light & Power Co.; capital $50,000.

Valparaiso, Ind.—People's Electric Company; capital $30,000. J. S. Cummings, O. S. Turner and others, incorporators.

Peru, Ind.—The Peru Electric Light & Power Company; capital stock $60,000. Paul E. Covington, Volney Q. Irwin among the incorporators.

West Bay City, Mich.—The Michigan Lighting Company; capital $10,000. Edward McGinnis, Frank Mohr and others incorporators.

Pittsburg, Pa.—The Electric Messenger Company, of Pittsburg, capital $25,000, was chartered recently to operate telegraph and telephone lines and exchanges in 37 counties in the state, including Allegheny, Armstrong, Beaver, Butler, Blair, Cambria, Centre, Clarion, Erie, Fayette, Greene, Indiana, Mercer, Venango, Washington and Westmoreland, and in New Jersey, New York, Ohio, Indiana, Illinois and West Virginia.

The directors are J. N. Pew, W. S. Miller and Joseph T. Colvin, Pittsburg; W. T. Marshall, Allegheny, and Samuel G. Pew, McDonald, Pa. Charter was also issued to Penn Loan Association, of Pittsburg, capital $1,000,000; directors, W. J. Black, J. P. McGill, Allegheny; W. H. Keech, O. H. Lloyd and J. T. Thompson, Pittsburg.

FINANCIAL.

The result of the election the first of last month gave a favorable turn to business in general. The result for the month has been fully up to expectations in supplies and apparatus. Manufacturers and dealers in material look for less trade until inventories are taken, orders being held over until the first of the year. The number of large orders booked during the month, however, gives every indication of a busy season. The amount of railway apparatus now under way is keeping that department of the larger companies busy. Many of the projects for interurban lines which were dropped on the approach of the financial depression of a year and a half ago, are being revived and pushed to the front. Electric lighting and telephone supplies have been in good demand and reports show a good number of new plants going in.

The stock market has been unusually quiet nnd no indication of any immediate activity. The Westinghouse stock is firm. The company is now occupying a part of its Brinton works and will soon have completed the change, as the work of removal is progressing as rapidly as the large amount of work on hand will permit. The earnings of the company are reported large and the number of recent orders especially good.

The stock of the General company has held its own and higher prices are looked for. Several large orders have been recently booked. Reports from the Lynn shops say the force there is to be increased and extensions made. The present conservative business management of the affairs of the company is commended by stockholders and although prices are way down they are not at all alarmed regarding results.

One of the most important events during the month was the completion of the purchase, by the Fort Wayne Electric Corporation, of the interests of the Fort Wayne Electric Light Co., and of the Baltimore factory. The able management which the corporation has will keep it to the front and it will secure a good share of the business.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING NOV. 25.
Miscellaneous Securities.						
American Bell Telephone Co.	Stock.	$17,500,000	100	....	J. Q.	198¼
“ “ “	Bds. 1898.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co.	Com.	14,000,000	100	....	....	90
Commercial Cable Co.	Com.	7,716,000	100	....	....	125
Edison Elec. Ill. Co., Boston	Com.	2,025,800	100	....	F. Q.	120
“ “ “	C. Bds. 1898.	71,000	100	6	M. & S.	.....
“ “ “	C. Bds. 1901.	586,500	100	6	M. & N.	.....
“ “ Brooklyn	Com.	2,500,000	100	....	Q. F.	85
“ “ “	1st. 1940.	500,000	100	5	A. & O.	100
“ “ “	Regis.	....	100	5	A. & O.	.....
“ “ Chicago	Com.	3,000,000	....	8	Q. F.	135
“ “ “		2,500,000	....	....	....	.....
“ “ New York.	Com.	7,938,000	100	....	Q. F.	101½
“ “ “	1st 1910.	2,562,000	100	5	M. & S.	107
“ “ Phila.	Com.	1,473,000	100	....	....	122
“ “ “		....	....	5	....	.....
Fort Wayne Elec. Co.	Com.	4,000,000	25	....	....	2¼
General Electric Company.	Com.	30,457,000	100	....	....	35½
“ “	Prf'd.	4,251,900	100	....	....	65
“ “	Deb. 1922.	10,000,000	100	5	J.-D.	88
Gold & Stock Tel. Co.	Com.	5,000,000	100	....	Q. J.	103
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	90
Thomson Elec. Welding Co.	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	...	....	.....
Thomson-Houston Elec. Co	Series D.	120,000	10	....	....	5⅜
Thom'-n-Houst'n Intern. Elec. Co.	Com.	600,000	100	...	....	.....
“ “ “ “	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co.	Com.	1,000,000	100	....	....	.....
“ “ “	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co.	Com.	94,820,000	100	....	Q J.	83
“ “	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	35½
“ “ “	1st Pf. Cum.	3,755,700	50	7	....	52½
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R.	Com.	6,000,000	10	....	Q.-J.	170
“ “	1st Bds. 1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R.	Com.	500,000	100	....	Oct. 1.	....
“ “ “	1st Bds. 1909	300,000	100	5	J. & J.	90
“ “ “	Certf. 1894.	300,000	100	6	J. & J.	100
BUFFALO—						
Buffalo St. Railway	Com.	5,370,500	100	5	....	57½
“ “	Bds. 1931.	5,000,000	100	....	F. & A.	100
BOSTON—						
West End St. Railway	Com.	9,085,000	50	..	J. & J.	47
“ “	Prf'd.	6,400,000	50	5	J. & J.	77
“ “	Bds. 1902.	3,000,000	100	....	M. & N.	100½
LOUISVILLE—						
Louisville St. Railway Co	Com.	5,000,000	100	....	....	33
“ “	Prf'd.	1,000,000	100	5	A. & O.	85
“ “	1st Bds. 1930	6,000,000	100	....	J. & J.	.....
NEWARK, N. J.—						
Newark Passenger Railway	Com.	6,000,000	100	....	....	27⅜
“ “	Bds. 1930.	6,000,000	100	5	J. & J.	93⅞
NEW YORK—						
Union Railway Co	Com.	2,000,000	100	....	....	155
“ “	Bds.	2,000,000	100	....	....	98
PITTSBURGH—						
Duquesne Traction Co	Com.	3,000,000	50	...	....	26½
“ “	Bds. 1930.	1,500,000	100	5	J. & J.	103
. St. & Pleas. Val. R. R.	Com.	1,400,000	50	....	J. & J.	20
“ “ “ “ “	Bds. 1919.	1,250,000	100	5	J. & J.	102
ittsb'gh, Aleg. & Man. R. R.	Com.	3,000,000	50	....		37
“ “ “	Bds. 1931.	1,500,000	100	5	J. & J.	103¾
Pittsburgh & Birming. R. R.	Com.	3,000,000	25	...	......	12½
“ “ “	Bds. 1929.	1,500,000	100	5	M. & N	95
ROCHESTER—						
Rochester Railway Company	Com.	5,000,000	100	...	....	67
“ “ “	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway	Com.	2,500,000	100	....	Q.-J.	99
“ “	Bds. 1910.	1,500,000	100	5	J. & J.	102
St. Louis & Suburban	Com.	2,500,000	100	....	....	17
“ “	Bds. 1921.	1,400,000	100	6	F. & A.	105
Union Depot Railway	Com.	1,200,000	100	....	....	100
“ “ “	Bds. 1910.	1,000,000	100	6	A. & O.	105

NEW BOOKS.

Facts About the South. By Richard H. Edmonds, editor of Manufacturers' Record. Baltimore, 1894. Paper, 32 pages.

In this pamphlet the author presents many facts concerning the South, and in doing so gives a history of the mining, iron and cotton industries of the South. In speaking of the decade ending 1860, the author says: "It witnessed a very marked growth in southern railroad and manufacturing interests, but there was no decline in the steady advance that was making the South one of the richest agricultural sections of the world. During this time railroad building was very actively pushed, and the South constructed 7,562 miles of new road, against 4,712 by the New England and middle states combined. In 1850 the South had 2,335 miles of railroad and the New England and middle states 4,798; by 1860 the South had increased its mileage to 9,897 miles, a quadrupling of that of 1850, while the New England and middle states had increased to 9,510 miles, or a gain of only about 100 per cent. The growth of other industries are also as clearly stated; the desolation of the South after the war and its struggle and success since, the advantages it offers to capital and enterprising business men are mentioned. Special reference is made to the agricultural products of the South.

TRADE PUBLICATIONS.

Numerous views of both the interior and exterior of prominent commercial buildings of the United States are given in a little pamphlet entitled "Heat Insulation and Fire Protection in Prominent Buildings," issued by the H. W. Johns Mfg. Co., of New York. The pamphlet presents, in an interesting manner, the extensive use of the Johns asbestos pipe and boiler coverings in steam plants. The views are neatly arranged and are well executed. The pamphlet will be preserved by many as an album of modern architecture as it shows clearly the design of the many mercantile blocks and public institutions recently erected. It is interesting since it places, convenient for comparison, the buildings of the different American cities. It contains also a list of the material manufactured by the above company, including the materials in the interest of which this pamphlet is issued, the fireproof paints, building material, the asbestos packings and vulcabeston material, and the mica insulating compounds for electrical installations.

The Allgemeine Electricitats Gesellschaft has recently issued an illustrated catalogue of its electric railway equipments for the overhead trolley systems. It is a volume of nearly 200 pages, nine by twelve inches in size, and is a companion volume to the one issued some months previous of general electrical apparatus and supplies. The volume is more a description of the electric railways of Europe, as it is filled with excellent views of the railway systems, together with maps of the lines and profiles showing grades. Cuts of machines and details of line construction accompany the descriptive matter. A variety of line construction is in use. In some of the cities in the narrow streets the span wires are fastened to the walls of the houses; on others, latticed iron posts support them, and on others, brackets support the trolley. The track work is also described. Methods of bonding, paving, etc., receive attention. Feeder wires and cables and overhead material are clearly illustrated. The volume presents in an excellent manner the practice of this company. Engineers will undoubtedly find many interesting features. The engraving and press-work are excellent. The book is substantially bound in cloth.

One of the first publications for 1895 received is the catalogue recently issued by The Lunkenheimer Company, of Cincinnati. It is a book of over one hundred pages and shows the line of steam specialties manufactured by this company. The Lunken gate and other improved forms of valves with renewable seat and disc have shown that advancement can be made in many of the standard goods which have been in use for years. It has heretofore been the custom, when the valve seat has become worn, to throw away the entire valve and replace it with a new one. The improvements in these valves makes the shell a part of the system as long as the pipe to which it is attached. When the valve seat becomes worn, it is taken out and a new one inserted. The amount of metal renewed being very small indeed. In other steam and oil specialties which this company manufactures modern ideas are involved. The construction of the specialties are clearly illustrated in this catalogue by numerous cuts showing also the manner of renewing worn parts. The valves listed include every size in use, large and small and adapted for the various kinds of service. The lubricating devices are adapted for all kinds of machinery. The sight feed lubricators for engines are shown in a number of patterns, and are accompanied by cuts and descriptions showing methods of attachment and use. Light feed oil cups, manufactured in a large number of styles, occupy a large part of the catalogue. Drips, cups and trough are also included in the line of steam specialties manufactured. The company's goods are well known so that the character of the goods does not require mention. The attention given to the design and manufacture of brass and iron valves, lubricators and steam specialties has resulted in the line of goods represented in this publication. Users of this class of goods will appreciate the handy volume issued by the manufacturers.

Electric railway systems and apparatus are considered in a pamphlet issued by the Sperry Electric Railway Co., of Cleveland, O. The introduction deals with the organization and the success of the company in this particular field, and calls attention to the Sperry system illustrated and described in the succeeding pages. Distributed through the pages are many views of electric roads upon which the Sperry equipment is used. The cuts are of a very fine quality and show the system in practical use. The descriptive matter is further illustrated by cuts showing details of construction and arrangement of the various parts of the motor and controlling apparatus. The special advantages of the single motor equipment are first described. The method of supporting the motor elastically prevents the continuous jarring of the different parts and gives a smooth carriage to that part of the equipment. In fact, it rides as easily as the car body. The advantages of the equipment through the distribution of metal, and the strength on curves and grades are described. Its slow speed, effective work on slippery tracks, etc., special features of construction, and general strength and durability are clearly described. The electric brake, a recent invention of Mr. E. A. Sperry, is also described and illustrated in the latter part of the catalogue. The matter here contained on subject of brakes will be found of general interest. The experiments conducted, the conclusions drawn from past experience and the methods pursued to overcome the defects of the former methods of braking, will be found especiully interesting to railway men. The work of inventing this brake, and method of operating and constructing the new electric brake are described. In the appendix to the catalogue will be found some sayings regarding the electric brake, what motormen have to say regarding its use and also some extracts from the press. The catalogue is tastily gotten up and bound in a handsome embossed cover. The paper is an excellent quality book, and brings out the details of the engravings in a very satisfactory manner.

Mrs. Langtry's fortnight engagement at the Chicago Opera House bids fair to be one of the largest which has been played in Chicago for some time. Sidney Grundy's drama "Esther Sandraz" is presented the first week commencing December 10th, and a large audience is assured for each night. During her second week Mrs. Langtry will present several new pieces, including probably "Agatha Tylden, Merchant and Ship Owner" which has never been seen here, and her own version of Sardou's latest drama, "Patrie."

Correspondence Schools.

We mentioned last month the receipt of a number of publications relating to the "Correspondence Schools," at Scranton, Pa. Among these, and of most interest, are a large number of letters, nearly two hundred, written by students in respect to their experience and opinions of the system. It is the most original agency for technical education that has ever been devised, capable of an extension that has no visible limit, and portends a time when we will not set off a few of the most fortunate for education, but educate all up to the limits required in the application of the skilled arts. One effect will be to raise the standard of the ordinary courses in technical colleges and schools, because mediocrity can be attained at a tithe of the expense and in ways more congenial to most students.

The habit of writing out exercises is a good one, good in all kinds of mnemonic effort, and when to this is added the interest of a communication personally addressed, and the environment of a home, it is easy to discern the attraction of a correspondence system.

Among the papers mentioned is one sheet of examples in hydraulics that as a collection of educational problems is the best we have ever seen. When a set school book is done, and the plates made, there is an end, but in the present system a tentative course is possible. Change and improvement can go on continually; not only this, the problems submitted can be nicely graded to the requirement and capacity of the student, and can, by the facility for change, be made relevant to particular examples or practice.—Industry, San Francisco, Cal., October, 1894.

PERSONAL.

Mr. W. H. McKinlock, president of the Metropolitan Electric Company, is now in the east on business.

Mr. Horatio A. Foster, chief assistant to Prof. George Forbes, Mills building, New York, was a visitor to Chicago, November 30.

Mr. C. E. Brown, secretary of the Central Electric Company, is, we regret to learn, still confined to his house with malarial fever.

H. Ward Leonard sailed the first of last month for Europe, where he will investigate electrical apparatus and appliances of foreign manufacturers and the practice of European engineers.

BUSINESS NOTES.

The Westinghouse Electric and Manufacturing Co., Pittsburg, has removed the office of its New England agency from 620 Atlantic Ave., Boston, Mass., to the Exchange Building, 53 State St.

Queen & Co., Philadelphia, it is said, will now arrive at a speedy adjustment of its affairs. Orders are being filled as usual. The large stock carried has suffered little diminution and is being kept up in all departments.

The Fontaine Crossing and Electrical Company, Detroit, Mich., manufacturers of the Fuller automatic dynamos and motors, Fuller double voltage dynamo and other electrical apparatus is now represented in Chicago by Mr. F. P. Thorp, 1020 The Rookery, who has a large circle of acquaintenances in the trade, having been long connected with the industry.

Mather Electric Company, Manchester, Conn., has just put in a new lot of machinery and its factories are now running over time with full force. Among recent sales of multipolar direct connected dynamos the following are reported: Harry S. Smith & Co., Philadelphia, Pa., two 45 K. W.; Odd Fellows' Hall, Philadelphia, Pa., one 30, one 50 one 75 K. W.; South Chicago City Railway Company, one 75 K. W.; Bartram Apartment Building, Philadelphia; two 50 K. W.; J. Holt Gates, Chicago, one 60 K. W.; Wayne Hotel Detroit, Mich., one 45 K. W.; and belted multipolar dynamos as follows: Jones Bros. Electric Company, Cincinnati, one 50 horse-power, 220 volt; New Pittsburg Coal Company, New Pittsburg, Ohio, one 60 K. W., 250 volt and Morris Coal Company, Sand Run, Ohio, one 60 K. W., 250 volt.

Mr. Edward F. Austin, 95 Fifth Ave, Pittsburg, Pa., formerly salesagent in the Pittsburg district of the Altoona Manufacturing Co., has taken charge of Pittsburg office of the Phoenix Iron Works, of Meadville, Pa., the manufacturers of the well-known Dick and Church engines, boilers, feed-water heaters, ect. Mr. Austin already reports a number of orders, among which are a 15 by 18 engine to Jones & Laughlin, three 100 horse-power boilers for the Schenty Park Casino, specially designed for safety, etc., and a number of other orders. From the number of inquiries for these well-known goods a large winter trade is expected.

Goldsmith Bros., Chicago, refiners of platinum, report a very active business from electric light companies at present in the purchase of old incandescent lamp bases. This firm is one of the oldest in the country and makes a specialty of utilizing old lamp bases for the plantinum they contain, and business entrusted to it is always sure of prompt attention. The firm also deals in platinum wire and plate.

The Dearborn Electric Company, 19 Quincy St., Chicago, has just been organized to succeed the business of T. C. Rafferty & Co. Owing to its increase of business the old firm was compelled to make this change and has moved into new quarters fitted up in a neat and convenient manner. The new company will carry a complete line of supplies and handle a number of specialties, among which is Bishop's rubber covered wires.

The Falkenau Engineering Company, Philadelphia, Pa., which was organized a short time ago, has been very successful in securing contracts and reports a large number of orders ahead. Electric lighting plants, underground cable work, and a large amount of special construction is being carried on. It has been awarded the contracts for the lighting of the Students' Hall, University of Pennsylvania, and for the Diocesan House, at Twelfth and Walnut Sts., and others.

The Metropolitan Electric Company, Chicago, reports business quite brisk in the filling of a large number of good-sized orders. Its business, in fact, during the past month was the best since its organization. The month of December, however, promises to be even better than last with this enterprising, driving concern. President W. H. McKinlock is consequently well satisfied with the prospects for large sales the coming year for all of the specialties, including N. I. R. wires, P. & B. paint, etc., handled by his company.

The Louis K. Comstock Company, electrical engineers and contractors, 1437 Monadnock block, Chicago, has opened an office at Detroit in the Hodges building. The office is in charge of Mr. Fredrick E. Newbury. The company is at work installing the electrical equipment in the new Chamber of Commerce building and a number of other contracts in Detroit. The established reputation of this company in the electrical field is a sufficient guarantee of its success in the business which now extends through the middle and western states.

The Nutting Electric Company, Chicago, is the name of a new corporation recently organized and will succeed to the business of the Nutting Electric Manufacturing Company. The litigation through which the old company has just passed made this new organization desirable and it is reported, will begin business at once. The specialty of this company will be arc lamps and the improved lamp for series and constant potential circuits is meeting with a good sale. The company is out with new catalogues and the outlook is very auspicious.

M. B. Austin, Chicago, opened up an office last month at 1533 Monadnock Block, where he will conduct the general western agency for the Safety Insulated Wire & Cable Co., of New York, and that of Holmes, Booth & Haydens, of Waterbury, Conn. Mr. Austin was connected with the Western Electric Co. for some time and more recently with the Knapp Electrical Works, and is therefore well-known to the trade. The specialties which he will handle are well known and he will, without doubt, be successful in pushing their sales in the west.

The Consolidated Car-Heating Company, Albany, N. Y., has received the contract to equip one hundred and fifty cars of the West End railroad, of Boston, with electric car heaters. This is one of the largest orders ever let for car heaters and shows the growing demand for this modern method of heating. The number of electric heaters in use has grown rapidly and this winter the number, although the returns are not large, finds a large part of the electric roads with at least a part of their cars so equipped. The consolidated company has a larger number of orders in than ever before and in other departments a good business is reported.

The Electric Appliance Company, 242 Madison St., Chicago, promises a new catalogue of its street railway supplies in a short time. Much hard work has been expended in its production and some very desirable lines of specialties, including the Lynn, will be listed. Special prices have recently been made on the C. E. M. jacknife and motor switches. These switches have always been very popular. In wire, the "O. K." weather-proof and Paranite are always in demand. The store rooms are filled and emptied regularly; and new consignments are shipped almost before the cars are unloaded. Packard lamps and transformers are favorites with the trade and are shipprd from the Chicago office to all parts of the middle and western parts of the United States.

Mr. Elmer G. Willyoung, 1210 Betz Bldg., Philadelphia, Pa., who, for six years was the electrical expert of Queen & Co., has completed arrangements with Messrs. Walder Bros. & Co., London, the largest manufacturers of instruments of precision in the world, for acting as their sole American agent. He will also act as the agent of James White, Glasgow, Scotland, maker of Lord Kelvin's balances and electrostatic measuring instruments, and for L. Oetling, London, analytical and assay balances. Mr. Willyoung has just spent two months in Europe, during which time he also completed arrangements to handle the instruments of a number of other well-known foreign instrument makers. Mr. Clayton W. Pike is associated with Mr. Willyoung, who was also with Queen & Co., and had charge of their exhibit at the World's Fair.

The Electrical Engineering Company, San Francisco, Cal., which gives a large part of its attention to mining plants, is busy putting in a number of electrical plants for the operation of stamp mills, pumps, hoists, etc. Among the work at present engaged upon are plants for the Gold Valley Mining Company, of Gold Valley, Colo., consisting of two 60 horse-power motors for driving the stamps and a sufficient generating equipment, a 25 horse-power electric hoist and 30 horse-power generator for the Phoenix mine, Colo., and a pumping plant with 40 horse-power motor for the Taylor mine, in the same state. A large number of other plants are being figured on and for new uses in the mines. The above company have always been advocates of electric power for mines, and have been very successful in introducing it.

The General Electric Company announces a new line of station switches to meet the demand for a reliable switch which, sold at a low price, will nevertheless be durable and effective in their work as the high-priced goods. It is known as the Coper snap knife switch, and differs from the generality of station switches in that the contacts and lugs instead of being of cast metal are of pure copper stampings, the contacts having ample contact surface to avoid heating and consequent loss. The hinges of the blades which move in the back contacts are so designed as to give excellent conductivity. The handle and cross-bar are connected to the blades by strong spiral springs which pull the blade out, with a brake action, only after the spring is in considerable tension. Thus the danger of arcing is reduced to the minimum. The switches are mounted on bases of hard, white porcelain made by the General Electric Company at its own works at Schenectady, and are constructed in sizes from 75 amperes to 300 amperes, double and triple pole, with and without fuse holders.

The Joseph Dixon Crucible Co , Jersey City, N. J., is sending out to parties interested circulars on belts containing useful information from which is the following: "No one using leather belts can afford to be indifferent to their care. There is a certain amount of elasticity in all good leather belting, but time and continued hard work seem to destroy or at least weaken its power. Then comes the question whether it is better to simply tighten the belt or use some form of dressing. Experience of many very practical observers seems to favor the use of a good dressing, as tightening the belt strains it and calls for more engine power. A dynamo engineer who is transmitting 60 to 65 horse-power with a 50-foot link belt 8 inches wide running from a 72-inch pulley on driving shaft to a 13-inch pulley on dynamo, claims that freedom from jumping and flickering of the lights is due entirely to the belt dressing used and that tightening never helped. The superintendent of a large printing establishment has an 18-inch main belt now running its eighth year which has never been taken up, and it would be extremely hard to convince him that the dressing used does not preserve the life of the leather and keep it soft and elastic. Of course one should be careful what sort of dressing is used. Soap, rosin, tar and tallow should not be used at all. Even castor oil is criticized. The dressing used in the two cases cited was Dixon's belt dressing and leather preservative, which was the only article that would start the big driving belt used at the Paris Exposition in 1878, and keep it from slipping.

J. Holt Gates, 1139 Monadnock block, Chicago, reports the closing of one of the latest contracts for isolated plants. This contract calls for two 60 K. W. direct-connected Mather dynamos, and it is for the Galena Bldg., Monroe and Clark Sts., which has just been erected by M. Greenbaum & Sons, Chicago. This plant has been very carefully selected, and will consist of the latest and most approved designs of apparatus for isolated installation. The building will be wired for 2,500 lights, and no expense will be spared in making it a model plant. Mr. J. Holt Gates, who was among the first to systematically advocate the use of direct-connected machines, has been particularly successful in installing this class of work. The Mather multipolar generator, of the larger types, has given efficient service in the various places already installed. The machine is compact and requires very little attention when properly run, even under the strain always found in street railway service. Mr. Gates is installing six Card motor equipments for the Elkhart & Goshen railroad, also a Mather generator. For the Bloomington (Ill.) City railway he holds the contract for 100 K.W. Mather railway generator and two card motors. and at Fremont, O., for two Card motors. The Card Electric Company's factory is now entirely completed, and in active operation. This company's series parallel controller using quick-break switches is a new departure in street railway controllers, and is giving good satisfaction. Mr. Gates reports the sale of thirty-six motors, dynamos and generators in the month of October. The Elwell-Parker Electric Company, of which he is the western representative, makes a specialty of direct-connected alternators, as well as the heaviest class of railway generators.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

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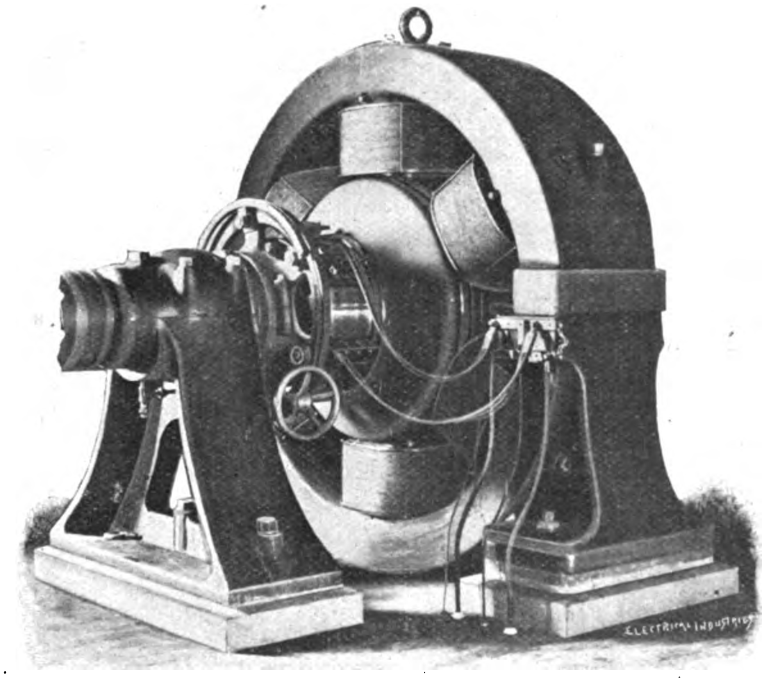

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Wallace Electric Co., 307 Dearborn st., Chicago.
Western Electric Co , Chicago.
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Whitney Elec Intstrument Co., Boston.

DYNAMOS.

Akron Electrical Mfg. Co., Akron, O.
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Bogue, Chas. J., New York.
Brush Electric Co., Cleveland, O.
C. & C. Electric Motor Co., New York.
Canton Electrical Co., Canton O.
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Detroit Dynamo Co. Detroit, Mich.
Detroit Motor Co., Detroit, Mich.
Easton Electric Co., Brooklyn, N. Y.
Eddy Electric Mfg. Co., Windsor, Conn.
Electro-Dynamic Co., 224 Carter st., Philadelphia.
Elektron Mfg. Co., Springfield Mass.
Elliott-Lincoln Electric Co., Cleveland, O.
Eureka Electric Co., 18 Broadway, New York.
Excelsior Electric Co., 115 Broadway, New York.
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Fontaine Crossing Co., Detroit, Mich.
Fort Wayne Electric Corporation, Fort Wayne, Ind.
Gates, J. Holt, 1140 Monadnock Blk., Chicago.
General Electric Co., Schenectady, N.Y.
Gregory, C. E. Co., 47 S. Jefferson St., Chicago.
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Hill, W. S., Electric Co., Boston.
Jenney Electric Motor Co., Indianapol
Kester Electric Co., Terre Haute, Ind.
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ELECTRIC HEATING.—(See Heating, Electric.)

ELECTRIC LIGHT APPARATUS.—(See Dynamos).

ELECTRIC LIGHT FIXTURES.—(See Electroliers and Combination Fixtures).

ELECTRIC LIGHT PARENT COMPANIES.—(See Dynamos.)

ELECTRIC RAILWAY SUPPLIES.

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Field Engineering Co., New York.
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McLeod, Ward & Co., 91 Liberty st New York.
Mailloux, C. O., 32 Liberty st., New York.
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Sargent & Lundy, Monadnock Building, Chicago.
Smith, R. B., Atlantic Bldg., Washington, D. C.
Smith, Thos. G., Jr., Hammond Bldg., Cincinnati, O.
Stagl, Charles, Commercial Bldg., St. Louis.
Van Nuis, C. S., New York.
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Boston Electric Co., Boston.
Brown Electric & Machinery Co., Little Rock, Ark.
Bunnell, J. H. & Co., 76 Cortlandt st. New York.

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Central Electric Co., 173 Adams st.' Chicago.
Central N. Y. Elec. Supply Co., Syracuse, N. Y.
Cleveland Electrical Mfg. Co., Cleveland O.
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Colgate, George L Co., New York.
Columbia Electric Co., St. Paul, Minn.
Columbia Electric Co., Worcester, Mass.
Consolidated Electric Mfg. Co., Boston.
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Dearborn Electric Co., 19 Quincy st., Chicago.
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Electrical Supply & Mfg. Co., Cleveland, O.
Electrical Supply Co., Springfield. O.
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Holtzer-Cabot Electric Co., Boston.
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Jones Bros. Electric Co., Cincinnati, O.
Jones, J. & Son, New York.
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Mountain Electric Co. Denver, Col.
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Novelty Electric Co. 54 North 4th st., Philadelphia.
Osburn Brothers, 304 Dearborn St., Chicago.
Partrick & Carter Co., Philadelphia.
Pennsylvania Elec. Eng. Co., Phila.
Pearce & Jones, 79 John st., New York.
Peninsular Gen. Elec. Co., The Grand Rapids, Mich.
Pettingell, Andrews & Co., Boston, Mass.
Pittsburgh Electric Co., Pittsburgh, Pa.
Post-Glover Electric Co., Cincinnati.
Providence Electric Supply Co., Providence, R. I.
Ries Electric Specialty Co., Baltimore, Md.
R. I. Telephone & Electric Co., Providence, R. I.
Saginaw Electrical Supply Co., East Saginaw, Mich.
Sawyer-Man Electric Co., New York.
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Southern Electrical Supply Co., St. Louis.
Southern Electric Supply Co., Baltimore, Md.
Standard Electric Co., Louisville, Ky.
Standard Electric Co., Philadelphia.
Standard Electrical Works, Cincinnati.
St. Louis Electric Supply Co., St. Louis, Mo.
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Universal Electric Co., Cleveland, O.
Utica Elec. Mfg. & Supply Co., Utica, N. Y.
Vallee Bros. & Co., 17 N. 6th st., Philadelphia.
Wallace Electric Co., 307 Dearborn St., Chicago.
Western Electric Co., Chicago.
Western Electrical Supply Co., St. Louis, Mo.
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Dickson Mfg Co., Scranton, Pa.
Rollison Gas Engine Co., 134 Liberty st., N. Y.
Schleicher Schumm & Co., Philadelphia, Pa.
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Beckett Foundry and Machine Co., Arlington, N. J.
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Hoffman & Billings Mfg. Co., Milwaukee, Wis.
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Ide, A. L., & Son, Springfield, Ill.
Lake Erie Engineering Works, Buffalo, N. Y.
Lane & Bodley Co., Cincinnati, O.
Lansing Iron & Engine Works, Lansing, Mich.
Leffel, James, & Co., Springfield, O.
McEwen, J. H., Mfg. Co., Ridgway, Pa.
McIntosh, Seymour & Co, Auburn, N. Y.
Mengerinhausen, W. H. von, York, Pa.
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New York Safety Steam Power Co., New York.
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Payne, B. W., & Sons, Elmira, N. Y.
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Providence Steam Engine Co., Providence, R. I.
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Skinner Engine Co., Erie, Pa.
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Stearns Mfg. Co., Erie, Pa.
Straight Line Engine Co., Syracuse, N. Y.
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Taylor Engine Co., Chambersburg, Pa.
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Wetherill, Robert, & Co., Chester, Pa.
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Wright, Wm., Newburgh, N. Y.

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Jones Bros. Electric Co., Cincinnati, O.
McIntyre, C., Co., Newark, N. J.
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FUSE WIRE.

Independent Electric Co., Chicago.
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GALVANIC APPARATUS.—(See Electro-Medical Apparatus).

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Whitney Elec. Instrument Co., Boston, Mass.

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Empire China Works, Greenpoint, N.Y.
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Pass & Seymour, Syracuse, N. Y.
Security Insulator Co., New York.
Standard Electrical Works, Cincinnati, O.
Thomas, R., & Sons, E. Liverpool, O.
Union Porcelain Works, Greenpoint, N. Y.
Wallace Electric Co., 307 Dearborn st., Chicago.
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LUBRICATORS.—(See Oil Cups and Lubricators).

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Warner & Swasey, Cleveland, O.
Williams, J. H., & Co., Brooklyn, N. Y.

MAGNET WIRE.

American Electrical Works, Providence, R. I.
Ansonia Brass & Copper Co., 21 Cliff st., New York.
Atlantic Covering Company, Plymouth, Mass.
Central Electric Co., 173 Adams st., Chicago.
Chicago Insulated Wire Co., 414 Northern Office Bldg., Chicago.
Electric Appliance Co., Chicago.
Great Western Mfg. Co., 120 Market st., Chicago.
Moore, Alfred F., 200 N. 3d st., Philadelphia.
Standard Electrical Works, Cincinnati.
Washburn & Moen Mfg. Co., Worcester, Mass.
Wallace Electric Co., 307 Dearborn st., Chicago.
Western Electric Co., Chicago.

MAGNETS—ELECTRO.

Varley Duplex Magnet Co., 64 Courtlandt St., New York.

MAST ARMS.

Brady, T H., New Britain, Conn.
Dillon Mast Arm Co., Indianapolis, Ind.
Morris, Tasker & Co., Philadelphia.
Russell Electrical Mfg. Co., Providence, R. I.
Star Iron Tower Co., Fort Wayne, Ind.
Walworth Mfg. Co., 16 Oliver st., Boston.

METALS, PERFORATED.

Mundt & Sons, New York.

METERS, ELECTRIC.

Fort Wayne Electric Co., Fort Wayne, Ind.
General Electric Co., Schenectady, N.Y.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

MICA.

Belden, F.E., Mica Mining Co., 38 School St., Boston.
Bowers Bros., Chicago.
Munsell, Eugene & Co., 218 Water st., New York.
Palermo Mica Co., 27 Peck slip, New York.
Schoonmaker, A. O., 158 William st., New York.

MICROPHONES—(See Experimental Apparatus).

MINING MACHINERY.

General Electric Co., Schenectady, N.Y.
Jeffrey Mfg. Co., Columbus, O.

MODEL WORK.—(See Experimental and Model Work).

MOTORS, ELECTRIC.

Adams Electric Co., Worcester, Mass.
Akron Electrical Mfg. Co., Akron, O.
Ansonia Electric Co., Chicago.
Baehr Elec. Mfg. Co., Brooklyn.
Bates, D. L. & Bro., Dayton, O.
Belknap Motor Co., Portland, Me.
Bogue, Chas. J., New York.
Card Motor & Dynamo Co., Cincinnati, O.
Chicago Water Motor & Fan Co., Chicago.
Commercial Electric Co., Indianapolis, Ind.
Consolidated Electric Motor Co., 95 Milk st., Boston.
"C. & C." Electric Motor Co., New York.
Crocker-Wheeler Electric Co., New York.
Dahl Electric Co., 120 Liberty st., N. Y.
Diehl & Co., New York.
Dallett, Thos. H. & Co., York st. and Sedgeley ave., Philadelphia.
Detroit Motor Co., Detroit, Mich.
Easton Electric Co., Brooklyn, N. Y.
Eddy Electric Mfg. Co., Windsor, Conn.
Electrical Engineering Co., San Francisco, Cal.
Elektron Mfg. Co., Springfield, Mass.
Elliott Electric Co., Cleveland, O.
Emerson Elec. Mfg. Co., St. Louis.
Fontaine Crossing and Electrical Co., Detroit, Mich.
Ft. Wayne Electric Corporation, Fort Wayne, Ind.
Gates, J. Holt, 1140 Monadnock Block, Chicago.
General Electric Co., Schenectady, N. Y.
Hill, W. S., Electric Co., Boston.
Jenney Electric Motor Co., Indianapolis, Ind.
Keystone Electric Co., Erie, Pa.
Knapp Electric & Novelty Co., 34 Warren st., N. Y
Kohler Bros., Chicago.
La Roche Electric Works, Philadelphia.
Lovell Mfg. Co., Ltd., Erie, Pa.
Mather Electric Co., Manchester, Conn.
Porter-Leavitt Electric Motor Co., Providence, R. I.
Porter Standard Motor Co., New York.
Premier Elec. Co., Brooklyn, N. Y.
Riker Electric Motor Co., Brooklyn, N. Y.
Rockford Elec. Mfg. Co., Rockford, Ill.
Shawhan-Thresher Electric Co., Dayton, O.
Sperry, E. A., Cleveland, O.
Waddell-Entz Elec. Co., Bridgeport, Conn.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.
Whitcomb, A. W., Worcester, Mass.

OIL BURNERS.

Aerated Fuel Co., Springfield, Mass.
Empire Hydro-Carbon Co., New York.
Standard Oil Fuel Burner Co., Fort Plain, N. Y.

OIL CUPS AND LUBRICATORS.

Aspinwall, F. B., 121 Liberty st., New York.
Besley, C. H., & Co., 175 Lake st., Chicago.
Detroit Lubricator Co., Detroit, Mich.
Ellis Lubricator Co., 296 Franklin st., Boston, Mass.
Hall, John S., New York.
Hoffman Lubricator & Oil Co., Binghamton, N. Y.
Lackawanna Lubricating Co., Scranton, Pa.
Lonergan, J. E., & Co., Philadelphia, Pa.
Lunkenheimer Co., The Cincinnati. O.
Michigan Lubricator Co., Detroit, Mich.
Nathan Mfg. Co., New York.
Powell, Wm., Co., The, Cincinnati, O.
Seibert Lubricator Co., 53 Oliver St., Boston.
Swift Lubricator Co., Elmira, N. Y.

OILS, LUBRICATING.

Binghamton Oil Co., Binghamton, N. Y.
Delaney, H. J., & Co., Milwaukee, Wis.
Dingee, M. H., & Co., 239 Water st., N. Y.
Harris, A. W., Oil Co., Providence, R. I.
Kuhne, F. J., 10 Front st., New York.
Lord, Geo. W., 316 Union st., Phila.
Smith & Nichols, New York.
Standard Oil Co., Cleveland, O.
Stuart, D. A., & Co., Chicago.
Taussig, S., 45 River st., Chicago.
Vacuum Oil Co., Rochester, N. Y.
Wadhams Oil & Grease Co., Milwaukee, Wis.

PACKING, STEAM.

American Steam Packing Co., Boston, Mass.
Asbestos Packing Co., Boston, Mass.
Brandt, Randolph, New York.
Brockett, W. E., & Co., Berlin, Wis.
Brown Electric Co., Boston.
Chubbuck, S. E., & Sons, Boston, Mass.
Common Sense Metallic Packing Co., New York.
Forest City Packing Co., Cleveland, O.
Garlock Packing Co., Palmyra, N. Y.
Goodsell, B. W., Chicago.
Gould Packing Co., East Cambridge, Mass.
Green, Tweed & Co., 83 Chambers st., New York.
Hine & Robertson, 45 Cortlandt st., New York.
Johns, H. W., Mfg. Co., 87 Maiden Lane, New York.
Merrill, W. B. & Co., Boston.
New York Belting & Packing Co., New York.
Tupper, F. W., New York.

PAINTS.

Dixon, Joseph, Crucible Co., Jersey City, N. J.
Standard Paint Co., New York.

PARAFFINE WAX.

Western Electric Co., Chicago.

PATENT ATTORNEYS.

Barton & Brown, Monadnock Bldg., Chicago.
Willson, H. B. & Co., Washington, D.C.

PINS AND BRACKETS.—(See Electrical Supplies.

PIPE AND BOILER COVERINGS.

Johns, H. W., Mfg. Co., 87 Maiden Lane, New York.

PIPE, GAS AND STEAM.

Allison Mfg. Co., Philadelphia, Pa.
Am. Tube Works, Boston, Mass.
Crane Bros. Mfg. Co., Chicago.
Cunningham Iron Works, Boston, Mass.
Eagle Steam Pipe Works, St. Louis. Mo.
Kelly & Jones, Pittsburgh, Pa.
Morris, Tasker & Co., 222-224 S. Third St., Philadelphia.
National Tube Works, Boston, Mass.
Walworth Mfg. Co., 16 Oliver st., Boston.

PLATINUM.

Baker & Co., Newark, N. J.
Schawel & Co., 29 John st., New York.

POLES, TELEGRAPH & TELEPHONE.

Ayer, Ed. E., Chicago, Ill.
Brownlee & Co., Detroit, Mich.
Chatterton, J. B., Minneapolis, Minn.
Coolidge Fuel & Supply Co., Minneapolis, Minn.
Great Western Mfg. Co., 120 Market st., Chicago.
Hubbard, F. A., Sandusky, O.
Loud, H. M., Lumber Co., Oscoda, Mich.
Milliken Bros., 55 Liberty st., N. Y.
Morris, Tasker & Co., 222-224 S. Third St., Philadelphia.
Rathbun, H. B., & Sons, Deseronto, Ont.
Standard Electrical Works, Cincinnati.
Stephens & Babcock, Saginaw, Mich.
Valentine-Clark Co., The Rookery, Chicago.

PORCELAIN FOR ELECTRICAL PURPOSES.

Century Pottery Co., Camden, N. J.
Empire China Works, Greenpoint, N.Y.
Greenwood Pottery Co., Trenton, N. J.
Pass & Seymour, Syracuse, N. Y.
Imperial Porcelain Works, Trenton, N. J.
Union Porcelain Works, Greenpoint, N. Y.

POROUS CELLS.

Central Electric Co., 173 Adams st. Chicago.
Mayer Pottery Co., Beaver Falls, Pa.
New England Pottery Co., 146 Codor St., East Boston, Mass.
Western Electric Co., Chicago

PULLEYS AND SHAFTING.

Allentown Rolling Mills, Allentown, Pa.
American Paper Pulley Co., Indianapolis, Ind.
Bates & Co., H. N., 120 Pearl st., Boston, Mass.
Bates Machine Co., Joliet, Ill.
Baugh Steam Forge Co., Detroit, Mich.
Bliss Shafting & Pulley Co., Chicago.
Brown, A. & F., 43 Park Place, New York.
Chicago Pulley & Hanger Co., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Eclipse Wind Engine Co., Beloit, Wis.
Fischer Foundry & Machine Co., Pittsburgh, Pa.
Frisbie, D., Co., New York.
Goodell & Waters, Philadelphia.
Hewes & Phillips Iron Works, Newark, N. J.
Hill Clutch Works, Cleveland, O.
Holyoke Machine Co., Holyoke, Mass.
Hunter, James, & Son, North Adams, Mass.
Jeffrey Mfg. Co., Columbus, O.
Link Belt Machinery Co., Chicago.
Poole, Robt., & Son Co., Baltimore, Md.
Sellers, Wm., & Co., Philadelphia.
Taper Sleeve Pulley Works, Erie, Pa.
Todd Pulley & Shafting Works, East St. Louis, Mo.
Walker Mfg. Co., Cleveland, O.
Williams, Milton F., & Co., St. Louis, Mo.
Williams & Orton Mfg. Co., Sterling, Ill.
Wood, Thomas, Philadelphia.
Wooden Pulley Mfg. Co., Minneapolis, Minn.

PUMPS, STEAM.

Barr Pumping Engine Co., Germantown, Phila.
Blake, G. F., Mfg. Co., Boston, Mass.
Blakeslee Mfg. Co., DuQuoin, Ill.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron, A. S., Steam Pump Works, New York.

Davidson Steam Pump Co., 77 Liberty st., New York.
Dean Bros. Steam Pump Works, Indianapolis, Ind
Deane Steam Pump Co., Holyoke, Mass.
Hughes Steam Pump Co., Cleveland, O.
Iowa Iron Works Co., Dubuque, Ia.
Knowles Steam Pump Works, 93 Liberty st., N. Y
Laidlaw & Dunn Co. Cincinnati O.
McGowan, John H., Co., Cincinnati, O.
Niagara Steam Pump Works, 120 Plymouth St., Brooklyn N. Y.
Pulsometer Steam Pump Co.. New York.
Stilwell-Bierce & Smith-Valle Co., Dayton, O.
Snow Steam Pump Co., Buffalo, N. Y.
Valley Pump Co.. East Hampton, Mass.
Wheeler & Tappan. Chicago.
Worthington, Henry R., New York.

PUMPS, ELECTRIC.

General Electric Co., Schenectady, N.Y.
Goulds Mfg. Co., Seneca Falls, N. Y.

PURIFIERS, FEED-WATER. — (See Heaters and Purifiers).

PUSH BUTTONS.—(See Electrical Supplies.

RAIL CHAIRS.

Elmira Railway Chair Co., Elmira, N. Y.

REFLECTORS AND SHADES.

American Reflector Co., Philadelphia, Pa.
Butler Mfg. Co., 46 S. Clinton St., Chicago.
Dayton Mfg. Co., Dayton, O.
Electric Appliance Co., 242 Madison St. Chicago.
Frink, Isaac P., 551 Pearl st., New York.
Gleason, E. P., Mfg. Co., 181 Mercer st., New York.
Globe Light and Heat Co., Chicago.
Great Western Mfg. Co., 120 Market st., Chicago.
Holman, F., Electrical Co., New York.
Kneeland Reflector Co., 24 Travers St., Boston, Mass.
McCreary Electrical Specialty Co., Electrical Exchange Bldg., New York.
National Reflector Co., Bellevue, O.
Phœnix Glass Co., New York.
Wheeler Reflector Co., 34 Washington st., Boston.

REGULATORS, PRESSURE.

Curtis Regulator Co., Boston, Mass.
Davis, G. M., & Co., 20 S. Canal st., Chicago.
Mason Regulator Co., Boston, Mass.
Watson & McDaniel, Philadelphia, Pa.

REPAIR WORK.

Bogue, Chas. J., New York.
Cutler-Hammer Manufacturing Co., Chicago.
Hartley Electrical Works, Chicago, Ill.
Linton & Southwitch, Boston, Mass.
Missouri Electric Repair Co., St. Louis, Mo.
Sioux City Brass Works, Sioux City, Ia.
Stanwood Mfg. Co., Clark and 17th sts., Chicago.
Varley Duplex Magnet Co., 64 Cortlandt st., N. Y.
Woolverton Electric Co., Rahway, N. J.

RHEOSTATS.

Weston, W. H. & Co., Philadelphia.

SCIENTIFIC APPARATUS.—(See Experimental Apparatus.

SCREWS AND RIVETS.

New England Screw Co., Boston, Mass.

SHAFTING.—(See Pulleys and Shafting).

SLATE.

Murphy, T. J., New York.

SOLDER.—(See Tin, Solder, etc).

SPEAKING TUBES.

Central Electric Co., 173 Adams st., Chicago.
Cooper, J. W., Medina, N. Y.
Electric Appliance Co., 242 Madison St. Chicago.
Empire China Works, Greenpoint, N.Y.
Ostrander, W. R., & Co., New York.
Walsh, Owen, 105 Walker st., New York.
Western Electric Co., Chicago.
Wollensak, J. F., Chicago.
Zimdars & Hunt New York-

SPEED INDICATORS.

Eddy Elec. Mfg. Co., Windsor, Conn.
Machinists' Supply Co., 169 Lake st., Chicago.
Schaefer & Badenburg, New York.
Stoelting, C H., Mfg. Co., Chicago.

SPRINGS.

Cary & Moen Co., 234 W. 29th st., New York.

STEAM TRAPS.

Albany Steam Trap Co., Albany, N. Y.
Clark & Co., Buffalo, N. Y.
Davis, G. M., & Co., Chicago.
Hames, Geo., & Co., Providence, R. I.
Huyett & Smith Mfg. Co.. Detroit, Mich.
Mason Mfg. Co., New York.
Rehm, Jos., & Co., Buffalo, N. Y.
Spaulding & Metcalf, Chicago.
Van Auken Brothers, Chicago.
Van Auken Steam Specialty Co., Chicago.
Williamson & Cassidy, Philadelphia.

STEEL CASTINGS.

Arcade Malleable Iron Co., Worcester, Mass.
Carnegie, Phipps & Co. (Ltd.) 15 Broad st., N. Y.
Chester Steel Castings Co., Philadelphia.
Howe, Brown & Co. (Ltd.), 12 Cliff st., New York.
Jessop, Wm., & Sons (Ltd.), 91 John st., New York
Otis Iron & Steel Co., 280 Broadway, New York.
Park, Bro. & Co. (Ltd.). 3 Cliff st., New York.
Sessions Foundry Co., Bristol, Conn.
Worcester Malleable Iron Works, Worcester, Mass

STEEL FOR MAGNETS.—(See Steel Castings).

STEAM SEPARATORS.

De Ryke, Jos., 145 Berry st., N. Y.
Hine Eliminator Co., New York.
Keystone Engine & Machine Works, Philadelphia.
Stratton Separator Co., 32 Cortlandt st., New York.

STEEL TUBES.

Lang, John S., 4 Fletcher st., New York.
Morris, Tasker & Co., 222-224 S. Third St., Philadelphia.
Wilmot & Hobbs Mfg. Co., Bridgeport, Conn.

STEPS FOR ELECTRIC CARS.

Stanwood Mfg. Co., Clark & 17th sts., Chicago.

STOKERS.

Brightman Stoker Co., Cleveland, O.

SWITCHES, ELECTRIC.—(See Cut-Outs and Switches).

TAPES, INSULATING.

Bishop Gutta-Percha Co., 424 E. 25th st., New York.
Central Electric Co., 173 Adams st., Chicago.
Cutter, George, Rookery, Chicago.
Eastern Electric Cable Co.. Boston, Mass.
Electric Appliance Co., 242 Madison St. Chicago.
Godfrey & Clark Paper Co., Pittsburg.
Goodrich, B. F., Co., Akron, O.
Metropolitan Electric Co.. 186 and 188 Fifth Ave., Chicago.
Moore, Alfred F., 200 N. 3d st., Philadelphia.
New York Insulated Wire Co., 651 Broadway, N. Y.
Okonite Co., 13 Park Row, New York.
Partrick & Carter Co., Philadelphia.
Simplex Electrical Co., Boston.
Standard Electrical Works, Cincinnati.
Standard Paint Co., New York.
Wallace Electric Co., 307 Dearborn st., Chicago.
Western Electric Co., Chicago.

TELEGRAPH APPARATUS.

Bunnell, J. H., & Co., New York.
Central Electric Co., 173 Adams st., Chicago.
Electric Appliance Co., Chicago.
Great Western Mfg. Co., 120 Market st., Chicago.
Greeley, E. S. Co., The, 5 Dey st., New York.
Jones Bros. Electric Co., Cincinnati, O.
Standard Electric Co., Louisville, Ky.
Standard Electrical Works, Cincinnati.
Western Electric Co., Chicago.

TELEGRAPH CONSTRUCTION. — (See Contractors).

TELEGRAPH POLES.—(See Poles, Telegraph and Telephones).

TELEGRAPH AND TELEPHONE SUPPLIES.—(See Electrical Supplies).

TELEGRAPH INSTRUMENTS. — (See Telegraph Apparatus.

TELEPHONE CONSTRUCTORS. — (See Contractors).

TELEPHONE POLES.—(See Poles, Telegraph and Telephone).

TELEPHONE, ACOUSTIC.

Elgin Telephone Co., Elgin, Ill.
National Telephone Mfg. Co., Boston.
Shaver Corporation, 78 Cortlandt st., N. Y.

TELEPHONES, ELECTRIC.

American Bell Telephone Co., 95 Milk st., Boston.
Cutter, George, The Rookery, Chicago.
Electric Appliance Co., 242 Madison St. Chicago.
Great Western Mfg. Co., 120 Market st., Chicago.
Imperial Telephone Works, Little Falls, N. Y.
Interior Telephone Co., New York.
Standard Electrical Works, Cincinnati.
Lasell, Edward, & Co., Chicago.
Western Electric Co., Chicago.
Viaduct Mfg. Co.. Baltimore, Md.
Ziegler Electric Co., 141 Franklin st., Boston, Mass.

TERMINALS AND SCREWS—(See Electrical Supplies and Screws).

TESTING BUREAUS.

Johns Hopkins University, Baltimore, Md.

TEST INSTRUMENTS.

Central Electric Co., 178 Adams St., Chicago.
Cushing, J. P., & Co., Boston, Mass.
Electric Appliance Co., 242 Madison St. Chicago.
Fort Wayne Electric Corporation, Fort Wayne, Ind.
Greeley, E. S., Co. The, New York.
Ritchie, E. S., & Sons, Brookline, Mass.
Varley Duplex Magnet Co., 64 Cortlandt st., N. Y.
Wallace Electric Co., 307 Dearborn st., Chicago.
Western Electric Co., Chicago.
Weston Electrical Instrument Co., Newark, N. J.
Whitney Electrical Instrument Co., Boston.
Wirt, Charles, 56 5th Ave. Chicago
Ziegler Electric Co., 141 Franklin st., Boston.

THERMOSTATS.

Western Electric Co., Chicago.

THREADS AND YARNS.—(See Insulating Material).

TIN, SOLDER, LEAD, ETC.

Bruce & Cook, 190 Water st., New York.
Burger & Lee, 378 Greenwich st., New York.
Colwell Lead Co., 63 Center st., N. Y.
Dickerson, Van Dusen & Co., 31 Cliff st., New York.
Merchant & Co., 517 Arch st., Philadelphia, Pa.
Pope's, Thos. J., Sons & Co., New York.
Raymond Lead Co., Chicago.
Whitney, B. S., 113 N. Fourth st., Troy, N. Y.

TOOLS.

Amidon Tool Corporation, Buffalo, N. Y.

TRANSFORMERS.

Crocker-Wheeler Electric Co., New York.
Diamond Elec. Co., Peoria, Ill.
Electric Appliance Co., 242 Madison St. Chicago.
General Electric Co., Schenectady, N.Y.
Hill Mfg. Co., Salem, Va.
Hornberger Elec. Mfg. Co., Elkhart, Ind.
National Electric Co., Eau Claire, Wis.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Electric and Mfg. Co., Pittsburgh, Pa.

TROLLY WHEELS.

Anderson, A. & J. M., Boston.
Haight & Clark, Albany, N. Y.

TRUCKS, ELECTRIC CAR.

Bemis Car Box Co., Springfield, Mass.
Brill, J. G. Co., Philadelphia, Pa.
Brownell Car Co., St. Louis, Mo.
Fulton Foundry Co., Cleveland. O.
Laing Machine Co., North Kankakee, Ill.
Lewis & Fowler Mfg. Co., Brooklyn, N. Y.
McGuire Manufacturing Co., Chicago.
Peckham Motor, Truck & Wheel Co., Kingston, N.Y
Randall, I. H., 1131 Tremont st., Boston.
Robinson Machine Co., Altoona, Pa.
Robinson Electric Truck & Supply Co., Boston.
Shaw Radial Car Truck Co., Boston.
Sheffield Velocipede Car Co., Three Rivers, Mich.
Stephenson, John, Co. (Ltd.). New York.
Taylor Electric Truck Co., Troy, N. Y.
Tripp Mfg. Co., Boston.

For reference to advertisers who are designated by heavy type, see index, on page V.

TUBE EXPANDERS.

Collins. Henry H., Pittsburgh, Pa.
Crescent Mfg. Co., Cleveland, O.
Dudgeon, Richard, 24 Columbia st., New York.
McCoy & Sanders, 26 Warren st., N. Y.

TURES.—(See Steel Tubes).

TURBINES.

Alcott, T. C., & Son, Mount Holly. N. J.
Chase Turbine Mfg. Co., Orange, Mass.
Dayton Globe Iron Works Co., Dayton, O.
Dubuque Turbine & Roller Mill Co., Dubuque, Ia.
Flenneken Turbine Co.. Dubuque, Ia.
Holyoke Machine Co., Worcester, Mass.
Leffel, James & Co., Springfield, O.
Pelton Water Wheel Co., San Francisco, Cal.
Risdon, T. H., & Co., Mount Holly, N. J.
Stilwell-Bierce & Smith-Vaile Co., Dayton, Ohio.
Stout, Mills & Temple, Dayton, O.
York Mfg. Co., York, Pa.

VALVES.

Am. Steam Gauge Co., Boston, Mass.
Ashcroft Mfg. Co., 111 Liberty st., N. Y.
Ashton Valve Co., Boston, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Consolidated Safety Valve Co., The, New York.
Crosby Steam Gauge & Valve Co., Boston, Mass.
Davis, G. M., & Co., Chicago.
Eddy Valve Co., Waterford, N. Y.
Jenkins Bros., 71 John st., New York.
Lonergan, J. E., & Co., Philadelphia, Pa.
Ludlow Valve Mfg. Co., Troy, N. Y.
Mason Regulator Co., Boston, Mass.
Roy Valve Co., New York.

VARNISHES.

Massachusetts Chemical Co., Boston, Mass.

VENTILATING FANS.

Andrews & Johnson Co., 249 S. Jefferson St., Chicago.
Bates, D. L. & Bro., Dayton, O.
Chicago Exhaust & Blow Pipe Co., Chicago.
Chicago Electric Mortor Co., Chicago.
Dayton Fan & Motor Co., Dayton, O.
Edison Mfg. Co., New York.
Globe Fan Co., 368 Broadway, New York.
Huyett & Smith Mfg. Co., Detroit, Mich.
Wing, L. J., Co., 126 Liberty st., New York

VULCANITE.—(See Hard Rubber).

VULCANIZED FIBER.—(See Insulating Material).

WATCHES AND CLOCKS, NON-MAGNETIC.

American Waltham Watch Co., Waltham, Mass.
Paillard Non-Magnetic Watch Co., New York.

WELDING, ELECTRIC.

Ries & Henderson, Baltimore, Md.
Thomson Electric Welding Co., 89 State st., Boston.

WHEELS, ELECTRIC CAR.

Peckham Motor Truck & Wheel Co., Kingston, N.Y.
Whitney, A., & Sons, Philadelphia, Pa.

WINDLASSES, ARC LAMP.

Cutter, George, The Rookery, Chicago.

WIPERS, SILK.

American Silk Mfg. Co., Philadelphia, Pa.

WIRE CORDS.——(See Wires.)

WIRE COVERERS.

Ketchum, Jos., 44 Lexington ave., Brooklyn, N. Y.
Robertson's Lead Incasing Works, Brooklyn, N. Y.
Western Electric Co., Chicago.

WIRE GAUGES.

Brown & Sharpe Mfg. Co., Providence R. I.
Ketchum, Joseph, & Co., Brooklyn.
Western Electric Co., Chicago.

WIRE TESTING AND COVERING MACHINES.

New England Butt Co., Providence, R. I.

WIRES.

BARE.

Aluminum Brass & Bronze Co., New York.
American Electrical Works, Providence, R. I.
Ansonia Brass & Copper Co., N. Y.
Bridgeport Brass Co. Bridgeport, Conn.
Bruce & Cook. 190 Water st., New York.
Central Electric Co., 173 Adams st., Chicago.
Chicago Insulated Wire Co., 414 Northern Office Bldg., Chicago.
Cushing & Morse, 225 Dearborn st., Chicago.
Dickerson, Van Dusen & Co., 31 Cliff st., New York.
Eastern Electric Cable Co., Boston.
Eureka Tempered Copper Co., North East, Pa.
Great Western Mfg. Co., 120 Market st., Chicago.
Holmes, Booth & Haydens, New York.
Lewisohn Bros., 81 Fulton st., New York.
Moore, Alfred F., 200 N. 3d st., Philadelphia.
Plume & Atwood Mfg. Co., Waterbury, Conn.
Roebling's, John A., Sons Co.. Trenton, N. J.
Standard Electrical Works, Cincinnati.
Standard Underground Cable Co., Pittsburgh, Pa.
Varley Duplex Magnet Co., 64 Cortlandt st., N. Y.
Washburn & Moen Mfg. Co., Worcester, Mass.
Wallace Electric Co., 307 Dearborn st., Chicago.
Western Electric Co., Chicago.

INSULATED.

American Circular Loom Co., 690 Atlantic ave., Boston.
American Electrical Works, Providence, R. I.
Bishop Gutta-Percha Co., 424 E. 25th st., New York.
Bradford, Kyle & Co., Plymouth, Mass.
Brigham Frank, W. Boston.
Campbell Electrical Supply Co., Boston.
Central Electric Co., 173 Adams st., Chicago.
Chicago Insulated Wire Co., 414 Northern Office Bldg., Chicago.
Cushing & Morse, 225 Dearborn st., Chicago.
Cutter, George, Rookery, Chicago.
Dearborn Electric Co., 19 Quincy st., Chicago.
Eastern Electric Cable Co., Boston.
Electric Appliance Co., Chicago.
Great Western Mfg. Co., 120 Market st., Chicago.
India Rubber & Gutta-Percha Insulating Co., N. Y.
Indiana Rubber & Insulated Wire Co., Marion, Ind.
Metropolitan Electric Co., 186 and 188 Fifth Ave., Chicago.
Moore, Alfred F., 200 N. 3d st., Philadelphia.
New Haven Insulated Wire Co., New Haven, Conn
New York Insulated Wire Co., New York.
Norwich Insulated Wire Co., New York.
Okonite Co., Ltd., 13 Park Row, New York.
Phillips Insulated Wire Co., 39-41 Cortlandt St., New York.
Safety Insulated Wire & Cable Co., New York.
Samson Cordage Works, Boston, Mass.
Simplex Electrical Co., Boston.
Standard Electric Works, Cincinnati, Ohio.
Standard Underground Cable Co., Pittsburgh, Pa.
Tatham & Bros., Philadelphia, Pa.
Wallace Electric Co., 307 Dearborn st., Chicago.
Wallace & Sons, 29 Chambers st., New York.
Washburn & Moen Mfg. Co., Worcester, Mass.
Western Electric Co., Chicago.

WOODWORK FOR ELECTRICAL PURPOSES.

Consolidated Elec. Assn. of Maine, Bar Harbor, Me.
Lever, C. H., Mfg. Co., Chicago.
Union Hardware Co., Torrington, Conn.
Viaduct Mfg. Co., 14 So. Charles st., Baltimore.

WRENCHES.

Billings & Spencer Co., Hartford, Conn.
Boston Wrench Co., Boston, Mass.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Sterling Wrench Co., Sterling, O.
Utility Wrench Co. (Ltd.), 231 E. 9th st., New York.
Williams, J. H.. & Co., 9 Richards st.. Brooklyn. N. Y.

ZINCS, RODS AND PLATES.

Bruce & Cook. 190 Water st., New York.
Central Electric Co., 173 Adams st., Chicago.
Edes, E. L., Plymouth, Mass.
Electric Appliance Co., Chicago.
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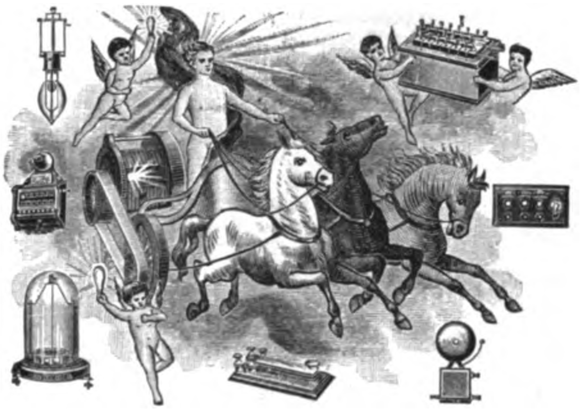

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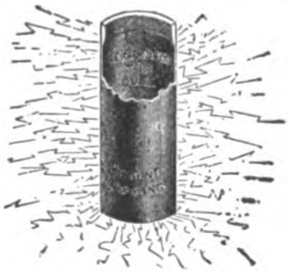

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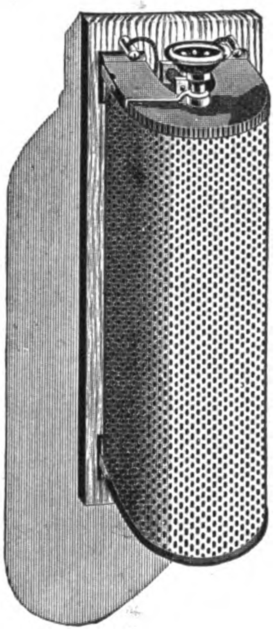

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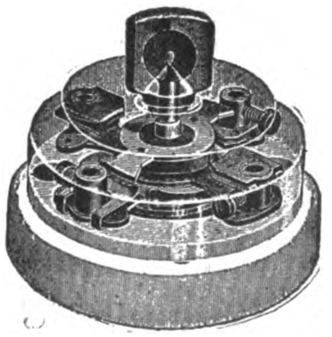

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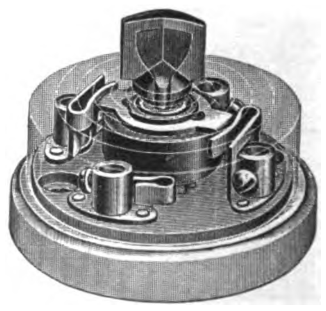

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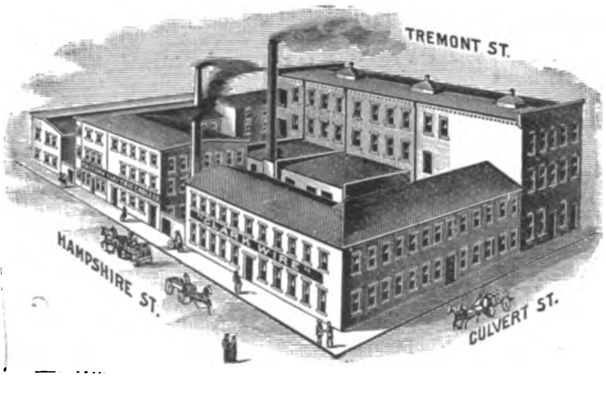
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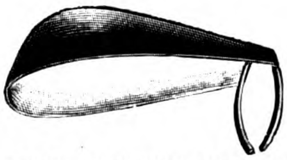

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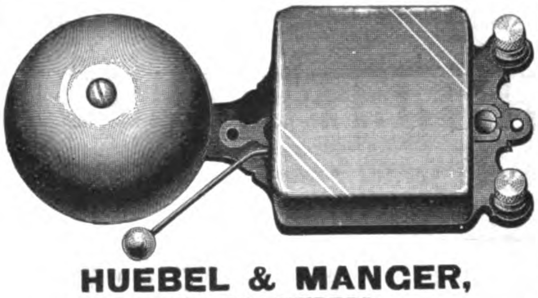

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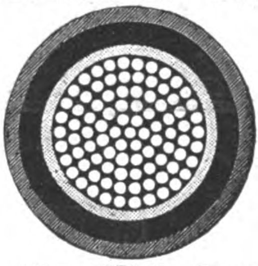

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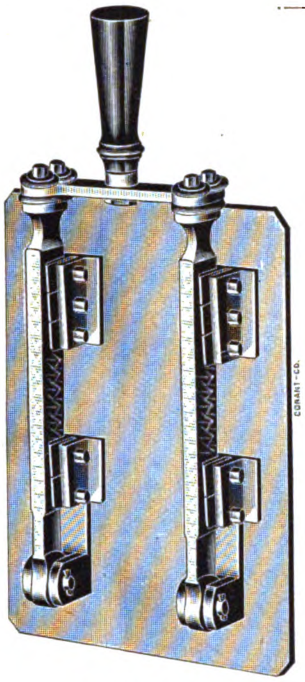

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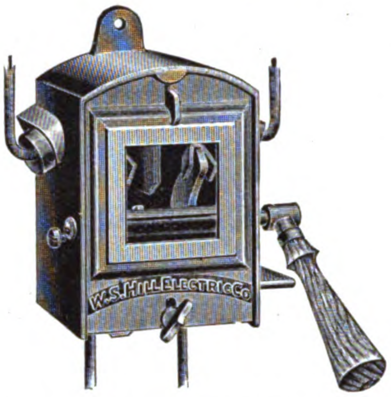

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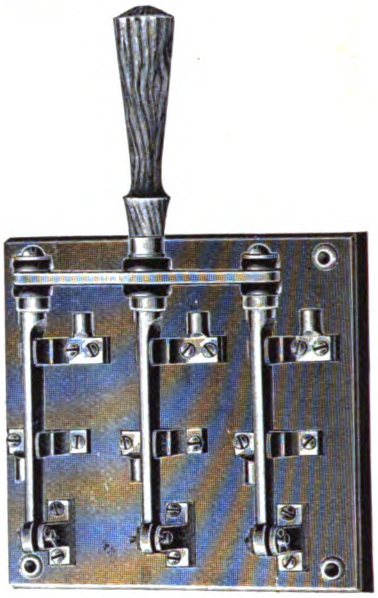

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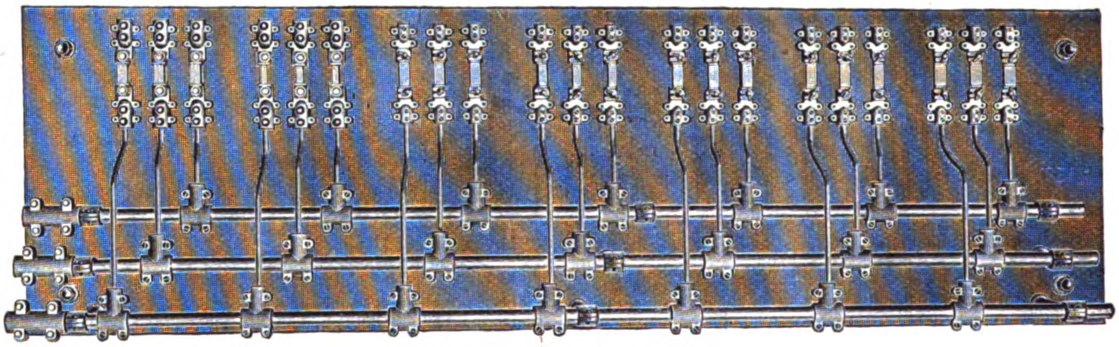

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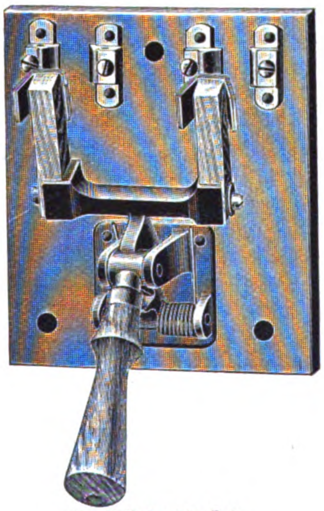

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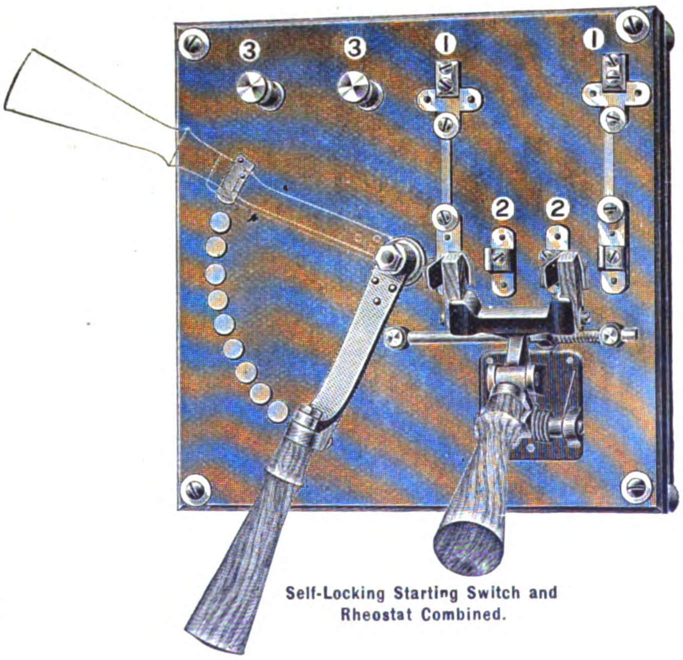

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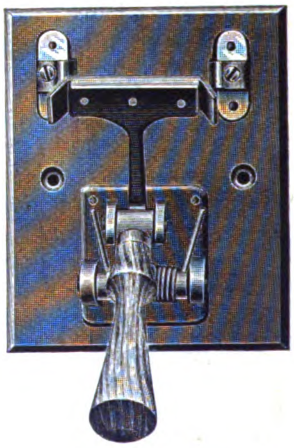

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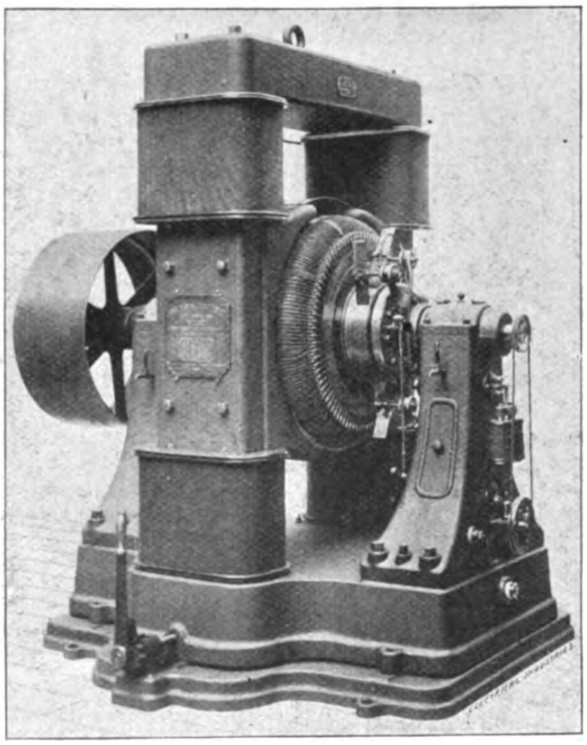

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Motors in all sizes and for all kinds of work.

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enabling arc lamps to be run on the incandescent circuit without the use of cored carbons, resistance or economy coils, and with a commercial efficiency of 88 per cent. The saving in the cost of carbons alone will pay for this apparatus in a short time.

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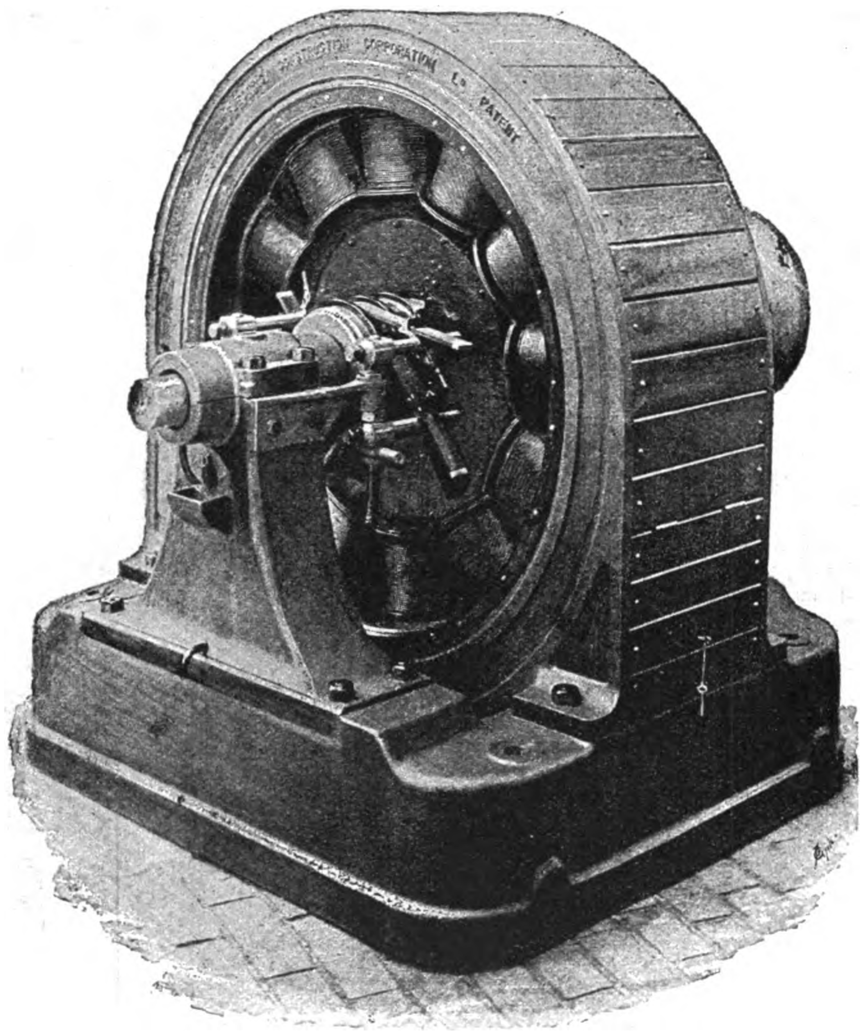

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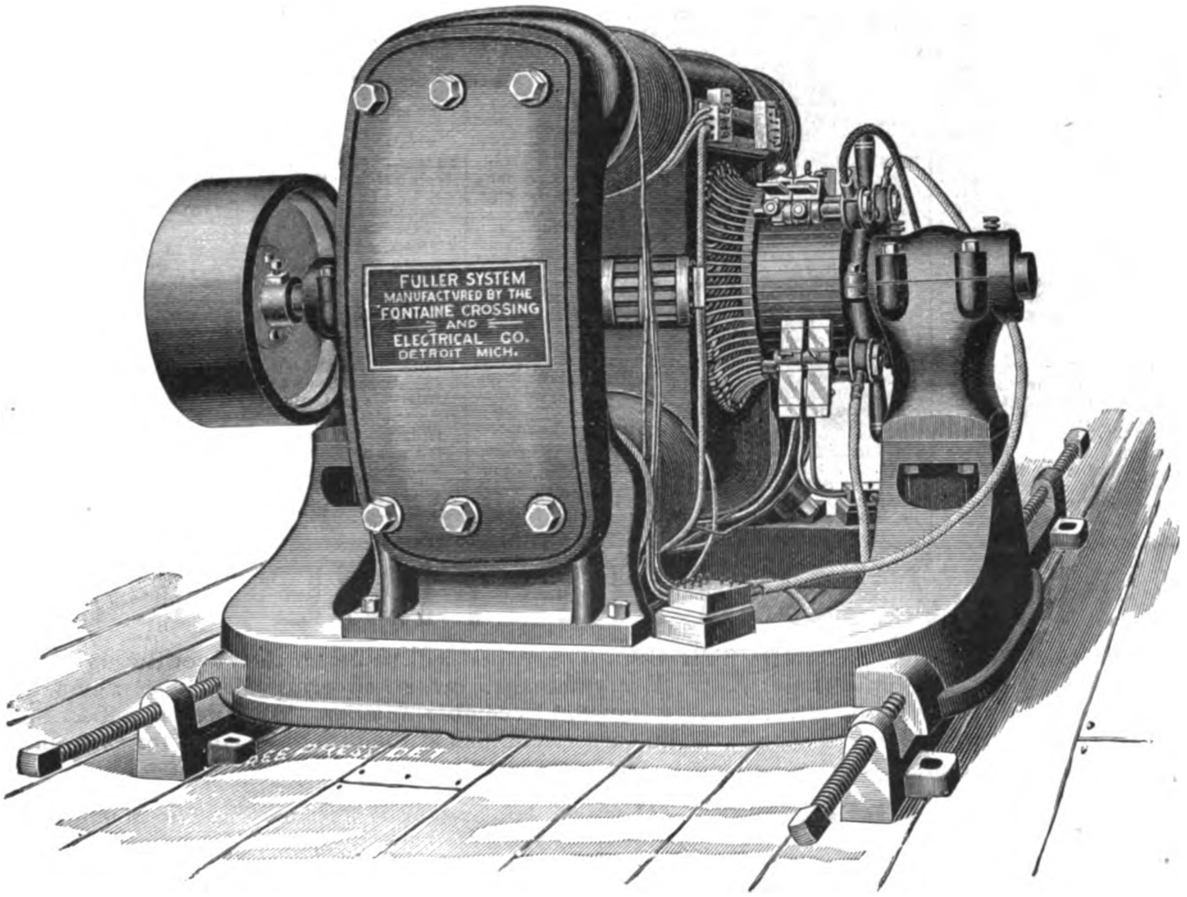

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ADDITIONS AND CORRECTIONS

TO "ELECTRICAL INDUSTRIES" DIRECTORY OF

ELECTRIC LIGHT CENTRAL STATIONS AND ELECTRIC RAILWAYS IN NORTH AMERICA.

The following additions and changes have come to hand since going to press with last issue of directory:

ELECTRIC LIGHT CENTRAL STATIONS.

ALABAMA.

SELMA—Sellma Gas & Elec. Ltg. Co.; cap. $31,000. W. P. Armstrong, Pres.; J. T. Russell, Jr., Sec.; 75 arc. and 450 altg. inc. General; no d. c.; 200 h. p. eng. Ball. K

CALIFORNIA.

BENICIA—Solano Elec. Lt. Co.; cap. $6.100. Thos. McKay, Pres.; P. F. Kenneth, Sec.; 26 arc General; 500 altg. inc. Westinghoure; Storage battery. K

COLORADO.

GLENWOOD SPRINGS—Glenwood Lt. & Pr. Co.; Cap. $270,600. W. B. Devereux, Pres.; T. H. Edsall, Sec.; F. H. Lyle, Treas.; W. H. Richardson, Pur- Agt.; 26 arc Brush 1,500 altg. inc. Brush and Westinghouse; no d. c.; 80 h. p. eng. Ball, 400 h. p. Pelton wheel. K

MANITOU—Manitou Elec. Co.; cap. $60.000. W. A. Bell, Owner; 42 arc and 2,000 altg. inc. General; no d. c.; 275 h. p. eng. K

ILLINOIS

HARVARD—H. S. Williams. Owner; cap. $10.000; 30 arc & 1,000 altg. inc. General; no d. c.; 130 h. p. eng. New York Safety. K

NEW ATHENS—New Athens Elec. Lt. & Pr. Co. cap. $4,500. I. Probst, Owner; 300 altg. inc. Westinghouse; no d. c.; 60 h. p. eng. Russell. K

WASHINGTON—Sun Elec. Lt. & Pr. Co.; cap. $12,000. Geo. C. Danforth; 850 altg. inc. General; no d. c.; 75 h. p. eng. Rice. K

IOWA.

BELLE PLAINE—Belle Plaine Elec. Lt. & Pr. Co.; S. S. Sweet. owner; 43 arc & 500 altg. inc. General; no d. c.: 150 h. p. eng. A. & S., Phoenix. K

ESTHERVILLE—Municipal Plant. Geo. Wiggins, Eln.; 13 arc & 600 altg. inc. Ft. Wayne; no d. c.; 100 h. p. eng. Buckeye. K

KENTUCKY.

MORGANFIELD—Morganfield Elec. Lt. & Pr. Co.; cap. $5,000. J. G. Taylor, Pres.; W. M. Wright, Sec. & Treas.; D. M. Rhea, Man. & Pur. Agt.; 400 altg. inc. General; no d. c. K

MAINE

ELLSWORTH—Ellsworth Elec. Illg. Co.; cap. $35,000. S. M. Hamill, Pres.; I. R. Prentiss, Sec. & Treas.; R. H. McMullan, Man. & Pur. Agt.: 30 arc & 1451 altg. inc. Brush: no d. c.: 160 h. p. eng. Buckeye, 160 h. p. turb. Holyoke. K

MANITOBA.

SELKIRK—Selkirk Elec. Co. (Ltd.); cap. $10,000. D. F. Reid, Pres.; F. W. Hooker, Sec., Treas. & Pur. Agt.; 700 altg. inc. National; no d. c.; 160 h. p. eng. Inglis & Sons. K

MARYLAND.

HAGERSTOWN—Hagerstown Elec. Lt. & Pr. Co.; cap. $60,000. W. E. Gutbrie, Mgr.; 225 arc Schuyler.; 1,600 altg. inc. Westinghouse; no d. c.; 325 h. p. eng. Taylor, Fitchburg. K

TOWSON—Mount Washington Elec. Lt. & Pr. Co.; cap. $30,000. C G. Hill, Pres.; M. W. Offutt, Sec. T. W. Offutt, Man. & Pur. Agt.; 500 altg. inc. Heisler; no d. c.; 100 h. p. eng. Atlas. K

WESTMINSTER—Carroll County Elec. Lt. & Pr. Co. M. Schaeffer, Pres. & Pur. Agt.; F. D. Miller, Sec. & Treas.; 450 altg. inc. General; no. d. c.; 100 h. p. eng. K

MASSACHUSETTS.

NANTUCKET—Nantucket Elec. Lt. Co. J. R. Bacon, Agt.; 50 arc & 1.200 altg. inc. General; no d. c.; 200 h. p. eng. McI. & S. K

PALMER—Central Mass. Elec. Co.; cap. $150,000. A. M. Young, (Waterbury) Pres.: W.W. Leach, Sec; C. B. Fiske, Treas.; 100 arc & 2,000 altg. inc. General; no d. c. K

MICHIGAN.

CHELSEA—Chelsea Elec. Lt. Co.; cap. $25,000. C. M. Davis, Pres.; F. P. Glazier, Sec., Treas. & Pur. Agt.; 50 arc General; 500 alt. inc. Heisler; no d. c.; 75 h. p. eng. Westinghouse. K

GLADWIN—Schulz & Prindle; 5 arc Mosher; 250 altg. inc. Westinghouse; 120 h. p. turb. K

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MINNEAPOLIS—Minneapolis General Elec. Co.; cap. $600,000. W. A Barnes, Pres.; J. W. Griffin, Sec.; A. A. Barton, Treas.; 1,800 arc & 21,000 altg. inc. Brush, General, Westinghouse; 2,000 h. p. eng Reynolds. K

Minneapolis International Elec. Co.; cap. $250,000. J. S. Porteous. Sec. & Treas.; 100 arc & 6,000 altg. inc. Siemens & Halske; 1,000 h. p. eng. N. Y., Ball. K

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MANCHESTER—Union Elec. Co.; cap. $150,000; bonds, $100,000. R. Whitney, Pres.; G. A. Leighton Sec. & Treas.; 50 arc & 7.000 altg. inc. Westinghouse; 1,000-50 v.; 400 h. p. eng. Woodbury, 750 h. p. turb. Hunt. K

NEW JERSEY.

LAMBERTVILLE—Hunterdon Elec. Co.; cap. $30,000. W. B. Bratton, 413 Drexel Bldg., Pres. & Pur. Agt.; D. S. Robinson, Sec. & Treas.; W. S. Newman, Supt.; 40 arc Standard & 700 altg. inc. Royal; no d. c.; 125 h. p. eng. Taylor. K

NEW YORK.

LOCKPORT—Lockport Gas & Elec. Lt. Co.; cap. $150.000. E. M. McMillin, Pres.; H. B. Wilson, Sec. & Treas.; 240 arc General, Brush; 330 altg. inc. General; no d. c.; 335 h. p. eng. A. & S. Ball. K

OHIO.

CHAGRIN FALLS—The Chagrin Falls Elec. Co.; cap. $10,000; bonds, $5,000. J. W. Hutchinson, Pres. & Gen. Man.; G. D. Gifford, Sec. & Treas.; 20 arc & 100 altg. inc. General; no d. c.; 100 h. p. eng. Cooper. K

HAMILTON—Municipal Plant; cost $100,000; 210 arc Western Elec. & — altg. inc. Stanley; d. c. 2,000-100 v.; 9.6 amp.; 800 h. p. eng Ham. K

IRONTON—R. T. McDonald; cap. $100,000. J. R. Cook, Man.: 30 arc & 4,300 altg. inc. Ft. Wayne; no d. c.; 650 h. p. eng. Taylor, Williams. K

NEW LONDON—New London Elec. Lt. Co.; cap. $4,000. D. J. C. Arnold, Pres.; E. R. Stilson, Sec. & Pur. Agt.; 125 altg. inc. U. S.; no d. c.; 50 h. p. eng. K

ONTARIO.

SAULT STE. MARIE—Sault Ste Marie Nor. Lt. & Pr. Co.; Cap. $400,000. R. N. Van Norman, Pres.; J. Bassingthwaite, Sec. & Treas.; T. E. Henderson, Man. & Pur. Agt; 500 altg. inc. Heisler; no d. c.; 100 h. p. eng. Dickey, — h. p. turb. K

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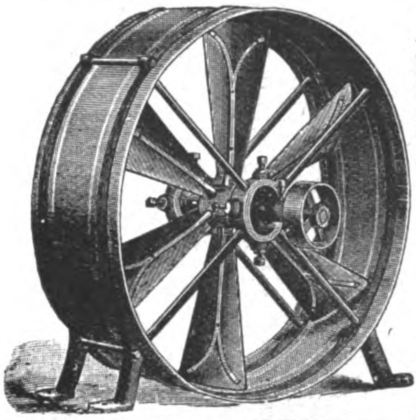

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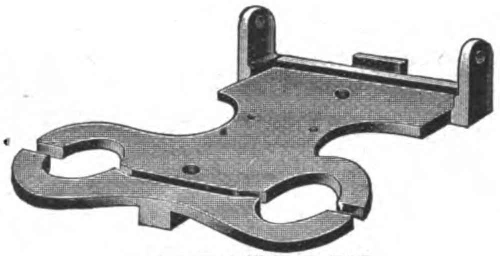

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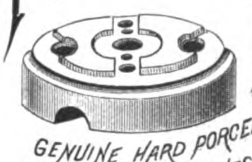

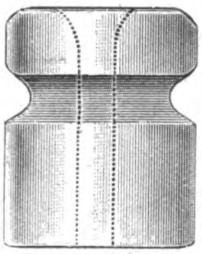

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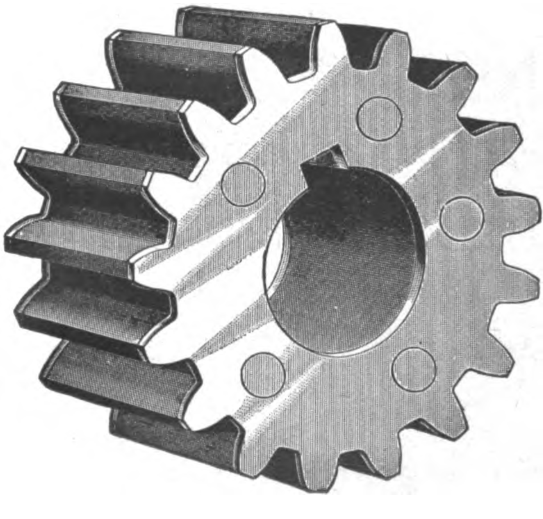

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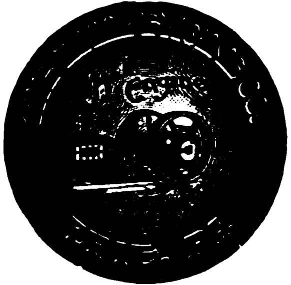

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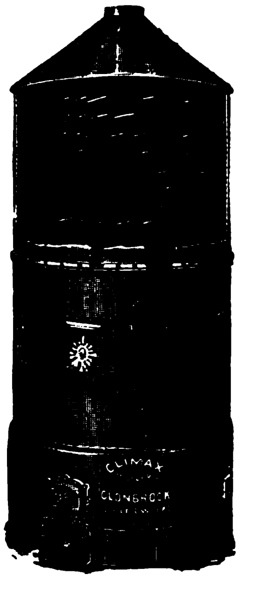

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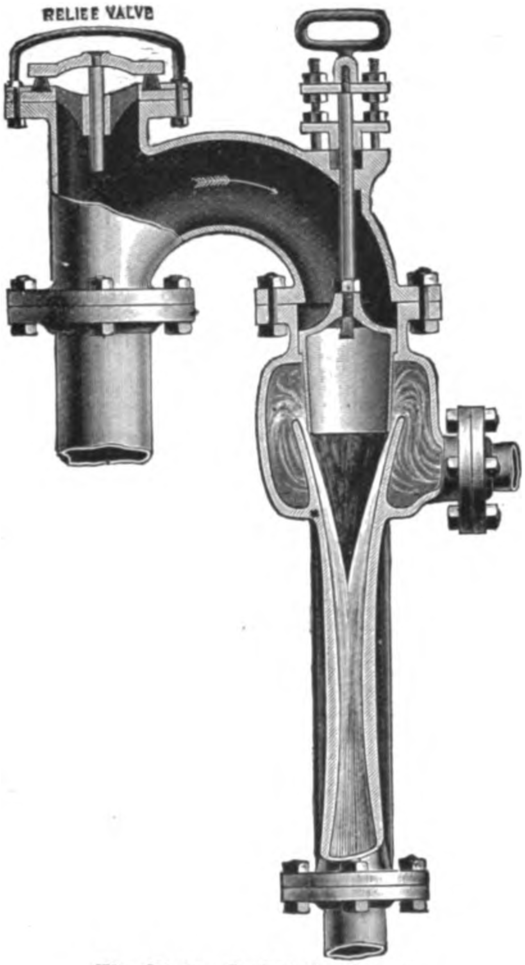

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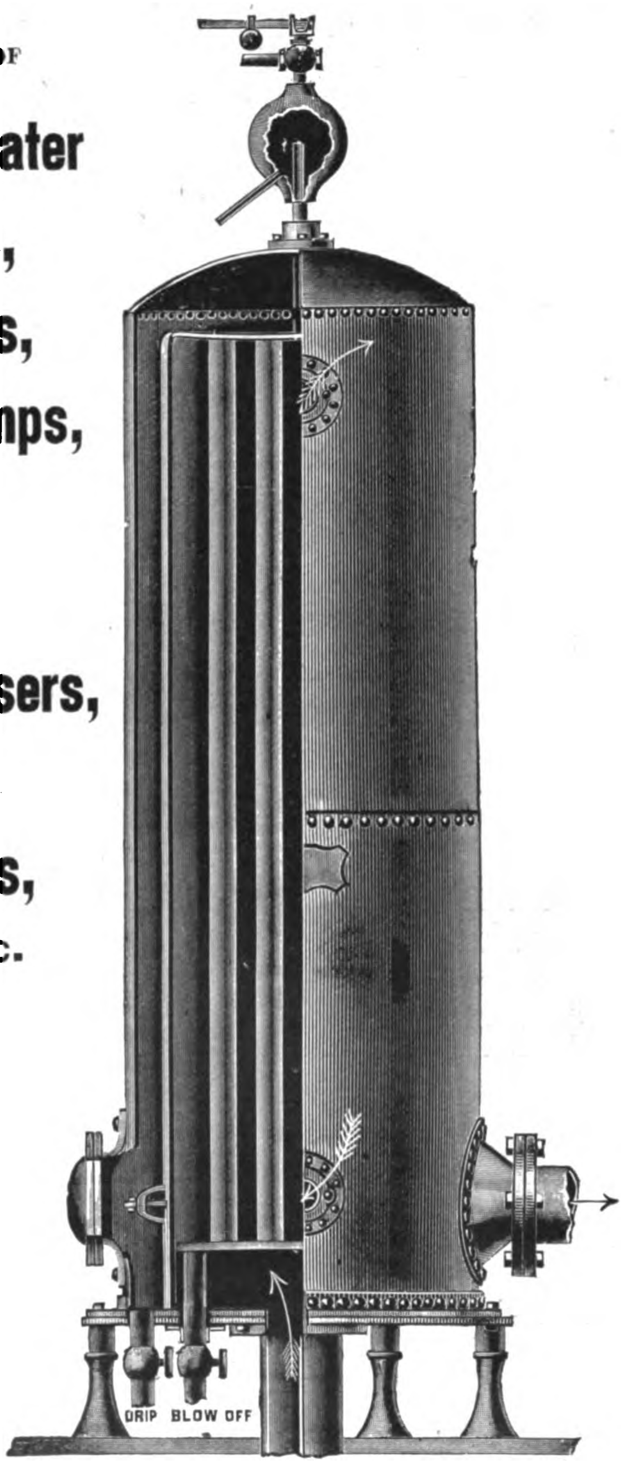

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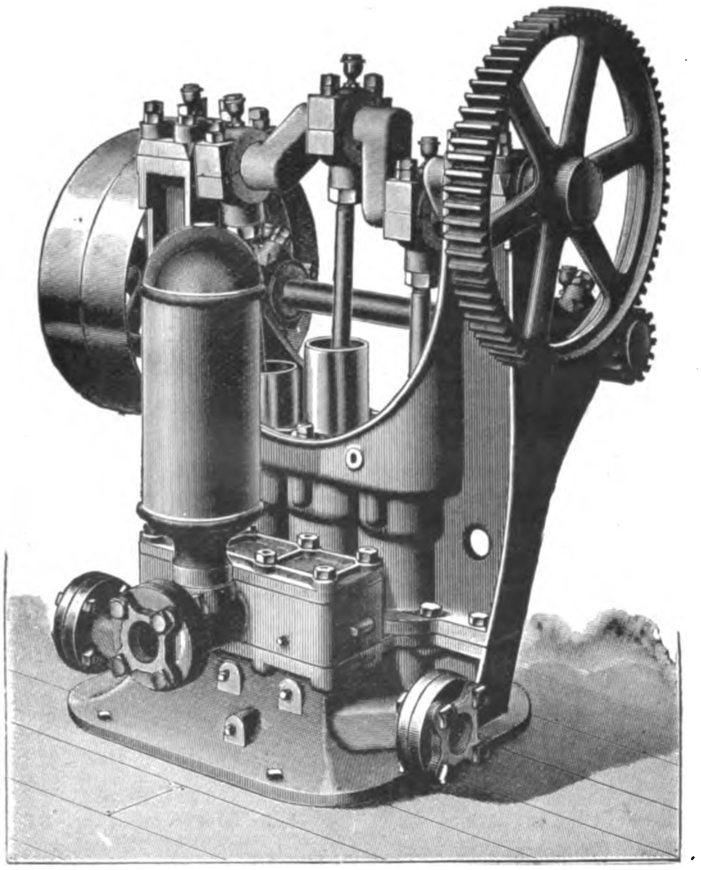

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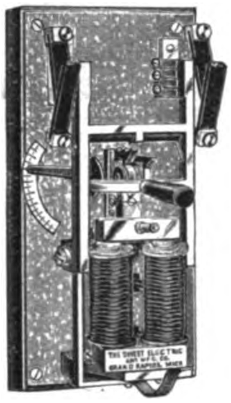

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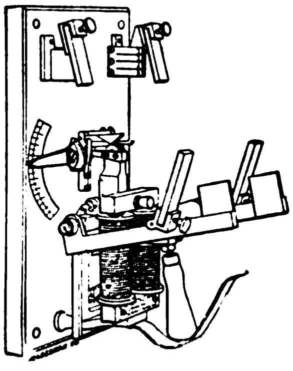

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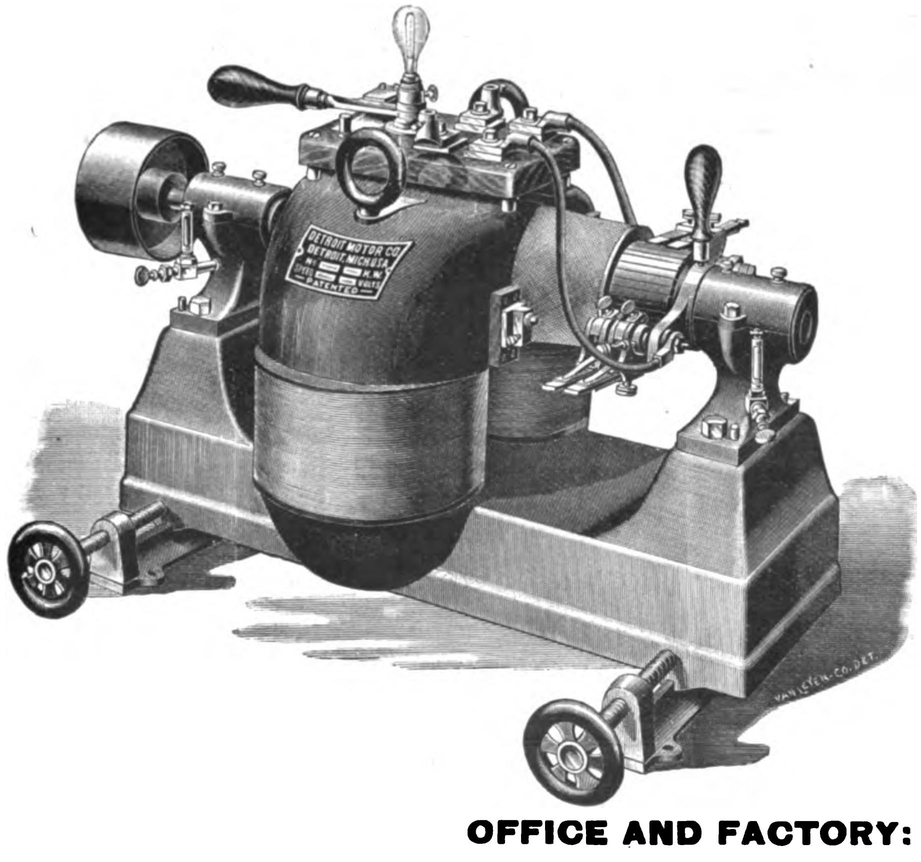
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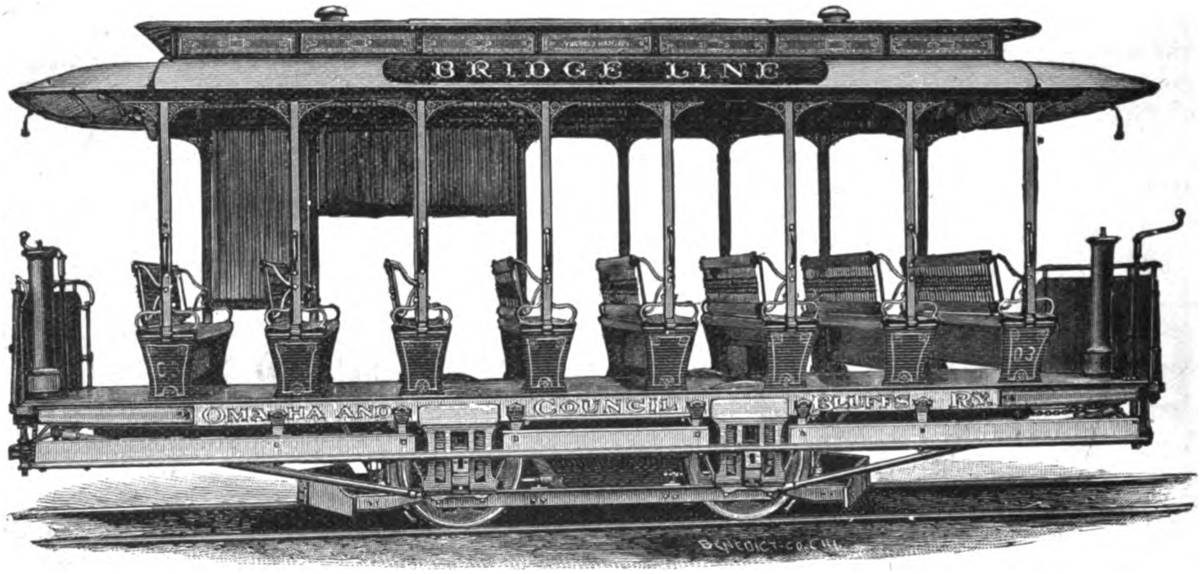
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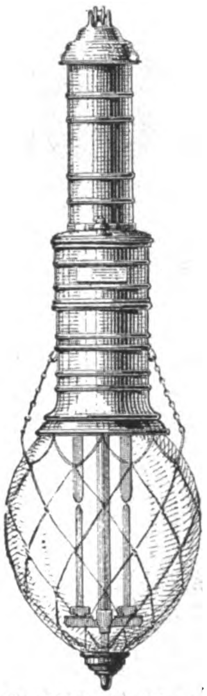

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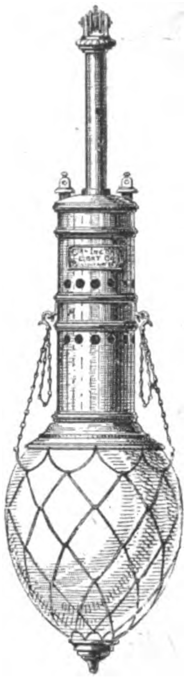

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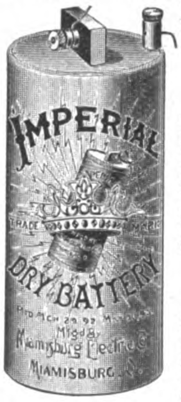

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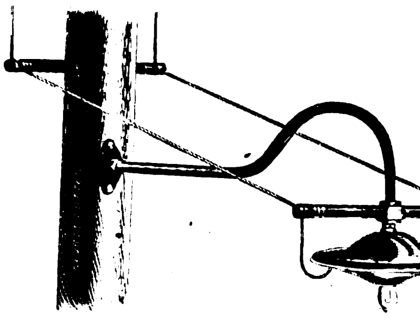

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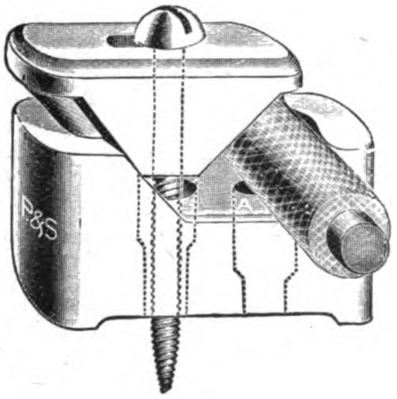

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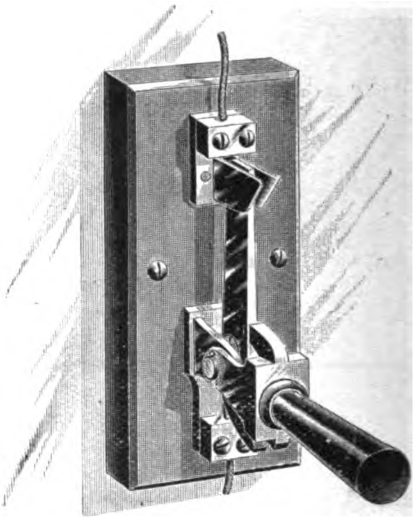

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DIRECTORY OF Electrical Associations.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—President, Edwin J Houston, Philadelphia: secretary. Ralph W. Pope, 12 West Thirty-first st., New York; regular meetings at 12 West Thirty-first st., third Tuesday of each month.

AMERICAN STREET RAILWAY ASSOCIATION.—President, Joel Hurt, Atlanta, Ga.; secretary, Wm. J. Richardson, Brooklyn, N. Y.; next convention at Montreal, Can., third Wednesday in October, 1895.

BUFFALO ELECTRICAL SOCIETY — BUFFALO, N. Y.—President, Frank Kitton; secretary, Astley C. Terry; regular meetings at Buffalo Library building, first and third Monday of each month; annual meeting third Monday in September.

CALIFORNIA ELECTRICAL SOCIETY—SAN FRANCISCO, CAL.—President, Geo. P. Low; secretary, W. I. Crossett, 229 Stevenson st.; regular meetings at Academy of Science building, first and third Mondays of each month; annual meeting first Mondays in February.

CANADIAN ELECTRICAL ASSOCIATION.— President, K. J. Dunstan, Toronto; secretary, C. H. Mortimer, Toronto; annual meeting in September.

CHICAGO ELECTRICAL ASSOCIATION—CHICAGO, ILL—President, Albert Scheible: secretary, H. G. Dim'ck, 227 South Clinton st.; place of meeting, 70 Adams street, next meeting in January.

ELECTRIC CLUB OF ST. LOUIS—ST. LOUIS, MO.—President, Robert McCulloch; secretary, Cliff R. Scudder. Meetings held at club rooms, in Equitable Building. Annual meeting third Monday in November.

ELECTRIC LIGHT ASSOCIATION OF PENNSYLVANIA.—President, Robert E. Wright, Allentown; secretary, Clarence H. Wolle, Bethlehem.

ELECTRICAL SECTION OF THE FRANKLIN INSTITUTE—PHILADELPHIA, PA.—President. Elmer G. Willyoung. 817 Filbert Street; Secretary and Treasurer, Robert H. Laird. 518 Girard Building; Meets fourth Tuesday in each month in the hall of the Franklin Institute.

HENRY ELECTRICAL CLUB OF THE AMERICAN INSTITUTE OF THE CITY OF NEW YORK.—President, W. H. Freedman and secretary, George W. Whitfield. Regular meeting every Wednesday evening at the rooms of the Institute, 111 to 115 W. 38th st., New York.

MANCHESTER ELECTRIC CLUB—MANCHESTER, N. H.—President, George I. Hopkins; secretary, Herbert W. Eastman; regular meetings third Monday of each month at club rooms, 34 Opera Block; annual meeting third Tuesday of March.

MICHIGAN STEET RAILWAY ASSOCIATION—President, W. L. Jenks; vice-president, W. W. Bean; secretary and treasurer, B. S. Hanchett, jr., Grand Rapids, Mich. Next annual meeting December 1895, at Grand Rapids.

MONTREAL ELECTRIC CLUB—President, W. B. Shaw: vice-president, H. Ritchie· secretary, James Burnett, 19 Shuter st.; treasurer, L. P. Pinolet.

NATIONAL ELECTRIC LIGHT ASSOCIATION.— President, M. J. Francisco, Rutland, Vt.: secretary, Geo. F. Porter, 136 Liberty st., New York; next convention at Cleveland, Ohio. February 19, 20 and 21.

NEW LONDON ELECTRIC CLUB — NEW LONDON, CONN.—President, J. R. Troland; Secretary. W. D. Harris; regular meetings every Thursday at 194 Bank St. Annual meeting in February.

NEW YORK ELECTRICAL SOCIETY — NEW YORK CITY.—President, Jos. Wetzler; secretary, George H. Guy, 533 Temple Court; regular meetings at Columbia College and elsewhere monthly; annual meeting in May.

NEW YORK STREET RAILWAY ASSOCIATION.—President, G. Tracy Rogers, Binghamton: secretary and treasurer, Wm. J. Richardson, Brooklyn. Next meeting September, 1895, at Albany.

NORTHWESTERN ELECTRICAL ASSOCIATION—President, C. C. Palge, Oshkosh, Wis.; Vice-President, W. B. Baker, Wanpaca, Wis.; Secretary. H. C. Thom. Semi-annual meeting at Milwaukee, January, 1894.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION—Next meeting September 5, 6, and 7 at Reading, Pa. Vice-president, Robert E. Wright, Allentown; secretary. S. P. Light, of Lebanon.

PITTSBURG ELECTRIC CLUB — PITTSBURG, PA.—President, Morris W. Mead; secretary, J. E. Hall; regular meetings at the Club house, 802 Penn. Ave., first Monday of each month; annual meeting May 2.

ST. PAUL ELECTRIC CLUB.—ST. PAUL, MINN.—President, George J. Burns; Secretary, C. H. Savage; regular meeting at rooms of the Manual Training School Monday and Wednesday evenings.

THE ELECTRIC CLUB — CLEVELAND, O.—President, C. W. Wason; secretary. H. J. Davis. Regular meetings at 356 Superior street, first and third Wednesdays of each month; annual meeting first Wednesday in October.

THOMSON SCIENTIFIC CLUB — LYNN, MASS.— President, James B. Cahoon; secretary, Franklin Sheble; regular meetings first and third Thursdays of each month at Club rooms, South st., and Western ave.; annual meeting third Thursday in December.

WISCONSIN ELECTRIC CLUB—MILWAUKEE, WIS.—President, Prof. A. J. Rogers; secretary, Jno. B. May; regular meetings at Club rooms, Goldsmith Block; alternate Fridays; annual meeting, first Tuesday in December.

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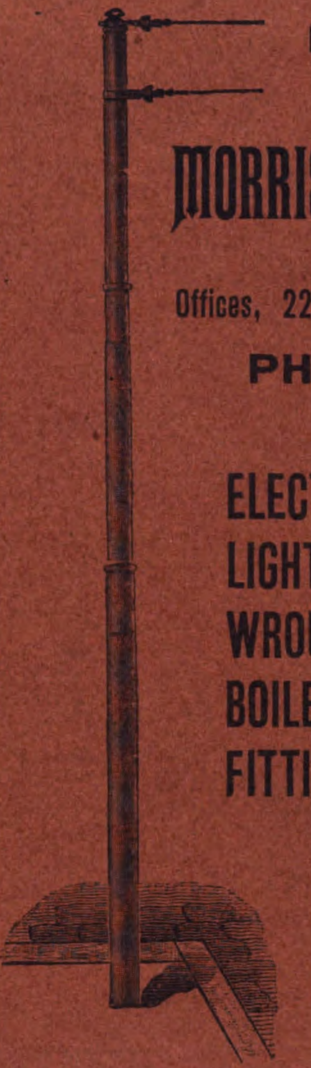

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On December 19, 20 and 21, the Wabash Line will sell excursion tickets from Chicago to all principal points in Canada at one limited first-class fare for the round trip. Tickets will be good going on any of above dates, and returning up to January 9, 1895, inclusive. Service strictly first-class. For maps, time tables, tickets, berths and full information, apply at City Ticket Office, 201 Clark St.

Hot Springs, Ark., Texas, Mexico and California. The Wabash Railroad.

Has placed in service a through first-class sleeper and tourist sleeper, leaving Chicago daily daily at 10-50 A.M., via St. Louis to Little Rock, Malvern (Hot Springs), Austin, San Antonio, Laredo, El Paso, Los Angeles and San Francisco. By six hours the quickest through sleeping car line Chicago to Malvern (Hot Springs). At Laredo direct connection is made with through sleeper for the City of Mexico—35 hours quickest time. For full particulars, address F. A. Palmer, A. G. P. A, 201 Clark St., Chicago.

"Their Moving Home."

It is well enough for artists to picture the old covered van drawn through the shady English lane, with the tinker, his family, and their lares and penates. That might do in England, or even in "these United States" in years gone by; but the Moving Home of today is a Vestibuled Limited Train such as the Erie lines are running daily between Chicago and New York—drawing-room, sleeping-cars, dining-cars and elegant day coaches, Pullman Company's build, lighted by gas, heated by steam—and in an hour's travel the modern "Home" will cover a long day's journey of the old van, while comfort, convenience and even luxury are all met with. It is only another case of "the people demand it," and the Erie lines, always in the front rank, meet their requirements.

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Beginning Sunday, October 7, a Palace Buffet Sleeping Car Service was inagurated between Chicago and New York City via the Nickel Plate Road and Delaware, Lackawanna & Western railroad. This in no way changes the former through-car arrangement.

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